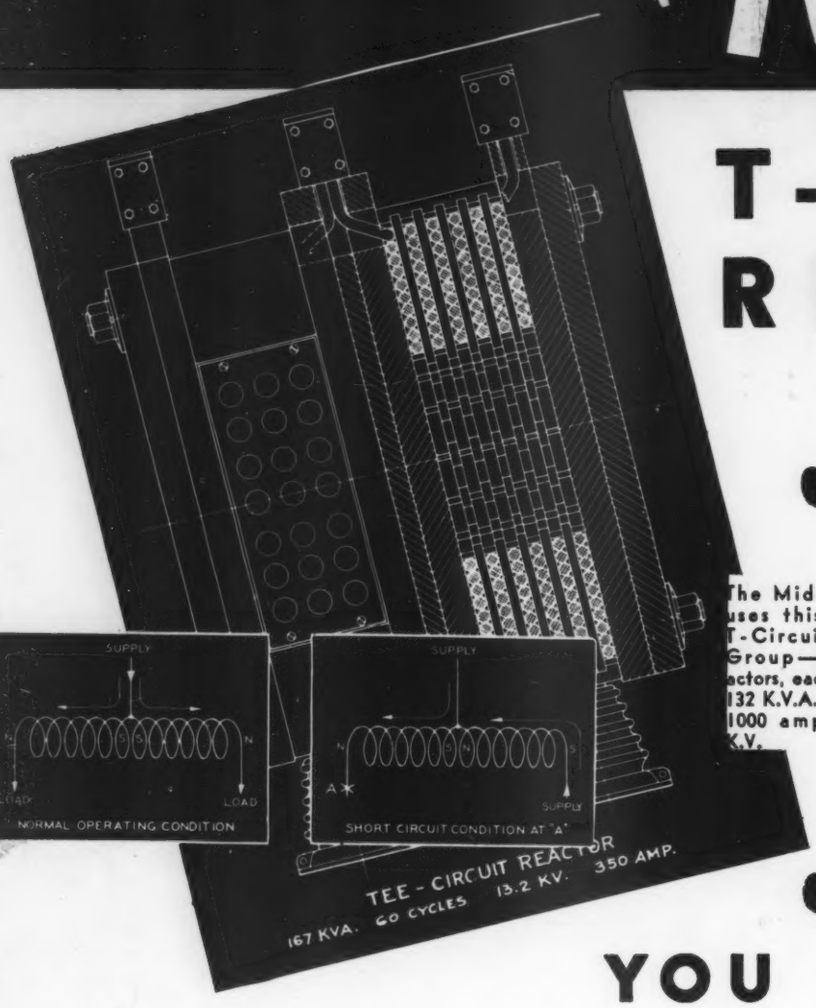
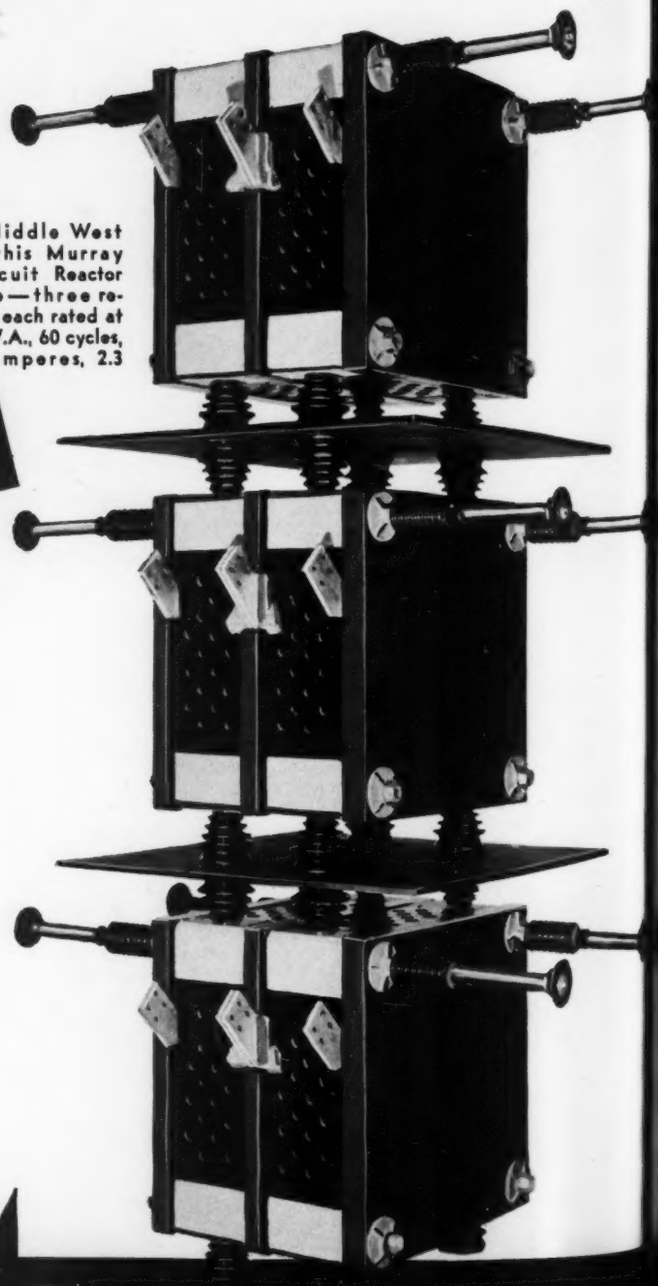
Murray

T-CIRCUIT REACTORS





The Middle West uses this Murray T-Circuit Reactor Group — three reactors, each rated at 132 K.V.A., 60 cycles, 1000 amperes, 2.3 K.V.

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YES SIR — 2 ways — comin' an' goin'. For ONLY T-Circuit Reactors are mutually inductive — which means that they automatically DEcrease the reactance during normal operation (gain No. 1) and INcrease the DROP in voltage during short circuits (gain No. 2). Metropolitan Device Corporation, Brooklyn, N. Y.

Metropolitan Device Corp.
1250 Atlantic Ave.
Brooklyn, N. Y.

Please send 32 page Murray Manual of Reactor Protection.

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Prepare

The uppermost question in the minds of everybody today is, Can we keep out of the war and for how long? The anti-war sentiment of nine months ago has not been standing up too well under the successive shocks of Finland, Denmark, Norway, Holland, Belgium. One thing is certain, the conduct of this war has shown that we are no longer non-vulnerable to attack.

This means that the United States must be prepared both for a war of defense and of aggression. The prayer in every one's heart is that we shall never have to use our armed forces. That prayer is the sooner answered when our preparations for war are proceeding fastest.

Sooner or later this war, like all other wars, will come to an end. At that time it will be desirable to have a strong non-participant at the peace table—one so strong that its opinions will be listened to with respect. And in that peace we must have a part because our interests are vitally affected. We must see that Europe is so set up that people are free to work and to buy, that markets are no longer closed, that gold returns to free use. It must be a peace that provides opportunity for America not only to resume its foreign trade but also to prevent an early recurrence of events so disturbing to our economy.

No such peace can be had unless the United States is in a position to back up its demands with force.

It goes without saying that preparation goes far beyond an army, a navy and an air force. It goes deep into all that supplies these forces. From the standpoint of generating plant the electrical industry is ready—has been ready for a long time. Is its distribution plant equally ready? If lines need strengthening or rebuilding, are the plans ready?

In many instances it might be found desirable to undertake this year work planned for next year. If this country becomes involved in the war, either as an active participant or as a supply depot for others, it might be found that today's low prices would make predated construction a good investment, even if the increased capacity were not needed for another year. It is also reasonably certain that as war work increases deliveries will become longer and more uncertain.

We also should begin to lay plans for handling the personnel problem. Anything that can be planned beforehand will make for less confusion later. In the last war, for instance, we let our utility commercial forces evaporate and later were sorry. Now is the time to study our mistakes of 1917 and 1918 and make plans based on experience. If ever the time comes when we might need such plans it is certain that without them we should make many of the same old errors, because we shall not then have time for research. In this connection a rereading of the article "War History," in ELECTRICAL WORLD, September 23, 1939, will be profitable.

Let us be prepared for anything. If we never need it the price will still be small.

E.E.I. Engineers Explore Operating Problems at Chicago

Cable corrosion, sunspot disturbances, dancing conductors, safety measures, standardization programs, systematized transformer maintenance, quick clearing of distribution faults, enliven discussion of wide range of current engineering practices

SESSIONS of the six engineering committees of Edison Electric Institute attracted well over 350 engineers to Chicago for the four days May 6-9, 1940. Added to the continuing activities of major and subject committees were a whole day's treatment of the growing problem of cable sheath corrosion and matters of immediate recent interest like the system disturbances caused by sunspot manifestations beginning Easter Sunday morning, March 24, 1940. The earlier glaze storm occasioned an epidemic of dancing conductors, which also precipitated animated discussion. Occasion for means for quick clearing of faults on distribution systems was discussed and important burnoff data presented by Detroit Edison Company.

These were some of the high points of a program which offered an unusual opportunity for those in attendance to pick up practical items of economical operation as well as to obtain an insight into the existing movements to expedite the industry standardization of such items as crossarms, current transformers, distribution transformers, utilization voltages, etc.

Magnetic Storm

Electron streamers from the sunspot eruption on Easter Sunday were the most violent recorded, said A. G. McNish of the Carnegie Institution of Washington at the Tuesday evening dinner. He said they induced currents of millions of amperes flowing in the earth from pole to pole and that the currents picked up by power and communication systems were the shunting of some 10-volt per mile potential differences at the surface. For more than two hours the earth was dissipating 2,000,000,000 kw. of induced circulation—more than four times the total of all the earth's potential hydro capacity. Also, it amounted to an energy absorption more than a U. S. consumption for a whole year. All this was the consequence of abrupt 5 per cent changes caused in the earth's magnetic field by the sunspot emission. Dr. McNish refrained from predicting a recurrence of this magnitude, but said the 1938 (sizable) disturbance was preceded by others in 1921, 1908, 1903, 1882, 1859, and suggested a 20-year likelihood.

W. F. Davidson, Consolidated Edison, summarized experiences of 22 utilities by citing voltage dips of 10 per cent, tripping of many transformer banks with differential protectors, a common 20 per cent increase in reactive kva., but very little, if any, disturbance to service. The effect was attributed to d.c. saturation of transformers on grounded neutral systems with consequent increased excitation, in reactive kva., in voltage drop and in losses. Losses just about offset the dip in New York load with lowered voltage, thus showing no perceptible change in total system load.

Dancing Conductors

Light glaze ($\frac{1}{8}$ to $\frac{1}{4}$ in.) on February 14 was charged by R. N. Conwell (Newark) with being the cause of widespread dancing of conductors of all voltages, conductor material and span lengths on the New Jersey system. Amplitudes as high as 18 ft. on the 13-ft. spacing of the 132-kv. system caused numerous tripouts, but relatively little service interruption because of fast clearing. Breakers were subjected to severe repetitive duty, but performed satisfactorily. Crossing of 132 kv. with 26 kv. caused only the loss of three arresters.

Mark Eldredge, Memphis, Tenn.; G. B. McCabe, Detroit Edison Co.; J. A. Brooks, Consolidated Edison Co. of New York, Inc.; C. N. Rakestraw, Cleveland Electric Illuminating Co.; T. E. Peterson, American Steel & Wire Co.

To eliminate whipping contacts at transposition structures a new cross-over on an H-frame was described by R. F. Danner of Oklahoma City. He proposed a spring-damper hanger for suspensions, but L. C. Peskin (American Steel & Wire) warned that elastic damping would merely change the frequency without altering the mode of motion. He said the most promising dampers were usually vulnerable to the weather and recommended change in elastic properties of the structures.

Cable Sheath Corrosion

Seven papers on the underground session gave a comprehensive picture of the growing seriousness of cable sheath corrosion as the fugitive traction currents of an earlier era are replaced by the chemicals now being imparted to subsurface soil. W. T. Pierce (American Steel & Wire) said that inasmuch as a length of cable may be subjected to a multiplicity of corrosive influences little can be done to take advantage of superiority of a particular alloy for a particular condition. This forces reliance on protective coverings.

To quote his own discussion " .... there has not been a universal demand on the part of purchasers for protection to cable sheaths from corrosion. The expense of such protection has militated against its use. The manufacturers suggest that an attempt be made to evaluate the cost of sheath corrosion and an economic study made to determine the increase in cost of cable that avoidance of sheath corrosion would justify."

Successful operation of a rectifier installation for cathodic protection depends, said A. S. Brookes (Newark) upon substantial construction of the ground electrode for long life and effective currents distribution. On the Public Service system a 30-ft. trolley rail is imbedded in a ton of coke breeze at a depth of 3 ft. Rectifiers with adjustable output have been found advantageous because the required current diminishes after a few days' operation. Over seven years 25 cathodic protection installations have been made. Of these 22 are copper oxide with output voltages 3 to 46 volts and current output of 2 to 22 amperes; the average energy requirements have been 28 watts per mile of cable.

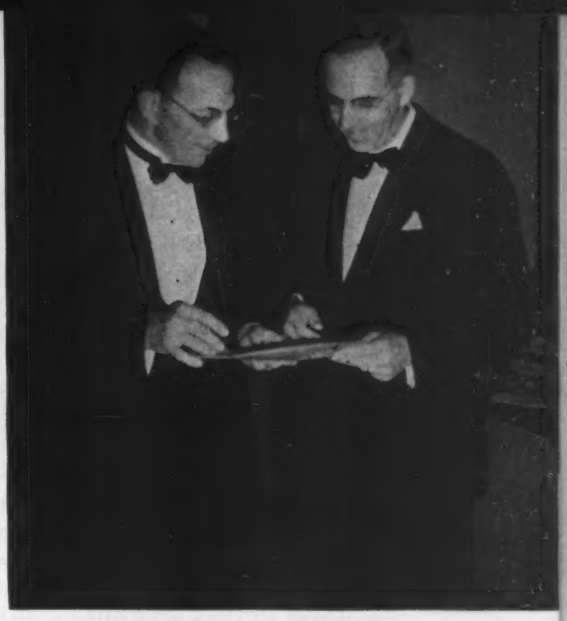
The sheath protection covering used by the New Jersey company is made up as follows: The sheath is coated thin with asphalt compound and butt-wound with layer of tape with its rubber facing outward. A second layer is half-lapped on with rubber side inward. Next, a rubber-filled tape, a high melting point wax and a dusting with powdered mica. The intermediate layer of rubber is vulcanized.

By various methods the rate of transmission cable failures due to electrolysis has been reduced from 2.9 per year per 100 miles in 1932-1936 to 1.9 for 1937-1939.

Detroit Edison, according to W. D. Sanderson, adds 1 per cent, by volume, of sodium silicate and sodium dichromate to the asphalt as inhibitors of corrosion. One quart of 40 per cent sodium silicate and a neutralized solution containing ½ lb. of sodium dichromate are put in 10 gal. of emulsified asphalt. This provides an excess of both chemicals to compensate for leaching in service. Five per cent of denatured alcohol prevents freezing. If the trench bottom is wet it is covered with tar paper. During the application the cable is supported on 4-in. blocks, which are removed in about an hour when the compound dries. Tile covering and backfill follow. Application takes 0.015 man-hour of field labor out of a total of 0.659 from start of excavation to backfill; inhibited asphalt and tile covers cost $0.015 and $0.092 per foot respectively. The portion of the total 75 to 80 cents per foot for installed cables is about 3 cents. One gallon of the compound does about 38 ft. of 350,000-circ.mil, three-conductor cable.

Zinc in Manholes

Voltmeters with resistance of 1,000,000 ohms per volt are now available for electrolysis surveys and they overcome contact resistance effects of the earth electrode, said L. J. Gorman (Consolidated Edison). He stated also that precast concrete ducts are superior to the monolithic, from the corrosion standpoint, presumably because they are air-cured for several months before use. A quantity of "Okosheath" covered cable has been installed on an experimental basis to determine its durability and effectiveness as a protective coating. In manholes zinc electrodes, 36x½x4 in., are placed on the



A. G. McNish, Carnegie Institution of Washington; W. F. Davidson, Consolidated Edison Company of New York, Inc.

A. B. Campbell, E.E.I.; W. F. Nimmo, Virginia Electric & Power Co.; Alexander Maxwell, E.E.I.

C. F. Merriam, Pennsylvania Water & Power Co.; C. W. Mayott, Connecticut Valley Power Exchange

floor and bonded to transformer tanks. Potential difference is 0.45 volt and current approximately 0.4 amp. After two years they are apparently unreduced in effectiveness.

A. G. Hull (Detroit) discussing cable sheath corrosion papers, found a dry duct system the answer to most electrolysis problems. He recommended high cement concentrations in concrete ducts where water is a problem, but disparaged the use of admixture in concrete to curtail corrosion. He felt that ½ cent per foot expense would be justified for the application of grease to cable sheaths for corrosion protection if it were possible to obtain a grease that would be stable in its characteristics.

T. G. Hieronymus (Kansas City Power & Light) reported satisfactory operation of bridge cable crossings where a lead sheath cable was installed in fiber-lined conduit. He indicated equal success with another bridge crossing where cable was suspended from messenger electrically isolated from the bridge structure by breakers. With asphalt-saturated jute braid corrosion protection for cable sheaths three to six years brought complete loss of mechanical strength in the jute, Hieronymus charged.

Branch Regulators

Discussion of C. E. Arvidson's (Commonwealth & Southern) paper on branch feeder regulators brought forth the comment from H. P. Seelye (Detroit Edison) that 6 per cent range on step-type regulators is enough and that he did not concur in Arvidson's suggestion of two fixed steps to give the equivalent of permanent boost. F. E. Sanford (Cincinnati) asserted that the use of an induction regulator on less than 150 kva. was questionable and that he did like the fixed-step proposal. D. K. Blake (G.E.) said the step regulators were introduced to extend the range coverable with any given voltage and not merely to aid "in getting out of a hole." It is a necessary adjunct of substation bus regulation.

Rubber Glove Testing

More details of the d.c. testing of rubber gloves by Boston Edison were given at a joint meeting of the electrical equipment committee, the transmission and distribution committee and the accident prevention committee (see ELECTRICAL WORLD, July 15, 1939). W. B. Elmer read for Chadbourne and Meade a paper which presented test results which showed that the number of voltage applications a glove will withstand varies inversely with the initial leakage current. High-voltage d.c. testing has been added as a permanent routine test on Boston Edison gloves. It reduces tremendously the arduousness of inspection and results in condemning only 1,500 gloves a year out of 10,000 tested, whereas with a.c. testing the discards were 2,540 because of rigid inspection standards on the visual examination.

At the Wednesday accident prevention session active discussion centered around a proposed resolution by Chairman W. R. Smith (Newark) reaffirming, 3,000 volts to ground as a safe upper limit for use of linemen's rubber gloves. Basis for the 3,000-volt limitation was its recognition as the point at which dangerous corona cutting in rubber begins. The resolution, unacted upon, was referred to the transmission and distribution committee for discussion. The proposed resolution arose out of requests that the accident committee sanction an increase in the upper limits for use of rubber gloves.

D. C. Stewart suggested study of relative merits of d.c. vs. a.c. rubber glove testing. He pointed to the d.c. test methods as: (1) Sure in picking out defects, (2) more rapid, (3) giving uniform results, (4) free from fluctuating stresses in rubber, (5) providing all information that a.c. test gives.

Appointment of a board of national authorities on electric shock and pulmonary disorders to study resuscitation case reports (which have been standardized for industry use) was reported. Findings of the board are to guide the accident prevention committee in recommendations regarding shock treatment and resuscitation by prone-pressure and pole-top methods.

Transformer Maintenance

Co-ordination of transformer maintenance with loading control is important in order to derive maximum benefit from transformer investment, said F. E. Sanford (Cincinnati) in his paper. If a transformer is to be loaded regularly to 140 or 150 per cent of rating it must be kept in good condition. A twelve-year program in Cincinnati on 12,000 distribution transformers has reduced lightning failures to 0.18 per cent and blown fuses to 0.72. The failure rate in 1932 was 0.81 per cent. A special four-man crew interconnects the grounds and removes the primary neutral gap; it makes a thorough inspection of primary and secondary connections and leads and reads the secondary voltage. The average job takes 45 minutes. The most effective schedule seems to dictate a six-year interval. Average cost per inspection is $3.09 per transformer or 50 cents per year (0.3 per cent per year on the investment).

Thorough shop repairs follow all removals for any cause. Average direct cost is $4.61, including materials at $2.07. Oil is handled and filtered at an average cost of 1½ cents per gallon. Supervision shop maintenance records and testing bring the direct cost to $8.91, which is about

G. V. Smith, Ohio Brass; C. A. Powel, Westinghouse Elec. & Mfg. Co.

G. W. Smith, San Antonio Public Service Co.

F. E. Sanford, Cincinnati Gas & Electric Co.; C. E. Arvidson, Consumers Power Co.

C. V. Waddington, Kansas Gas & Electric Co.; C. D. Brown, Wisconsin Electric & Power Co.; J. A. Tyvand, Wisconsin Gas & Electric Co.

E. R. Crofts, Rochester Gas & Electric Co.; C. Z. Gillivan, Southern Ohio Electric Co.; G. W. Smith, San Antonio Public Service Co.

7 per cent of the average transformer value. The number repaired per year is about 8.5 per cent of the total on the system. The total repair cost thus represents 0.6 per cent of total transformer investment.

Much interest was likewise manifested in Myron Zucker's description of Detroit Edison's method of X-ray pole inspection as described in ELECTRICAL WORLD, March 23, page 32. He added a description of the diagnosis and scales used in determining the moment strength of good wood and remaining life on a safety factor basis from the X-ray films.

Wire Burnoffs

Detroit Edison had in 1938 and 1939 in its 5,500 conductor miles of 4.8 kv. totals of 703 and 993 cases in which wires fell to the ground. This averages only one break per year in 65 miles of wire. While this is good performance, it was felt, said George A. Matthews, that the record could be bettered 50 per cent if power arcs following transient contacts could be limited to short duration. Study showed that: (1) With time-delay or instantaneous operations of conventional switchgear, serious damage to conductors could not be prevented. (2) To protect conductors against burn-down, the duration of arcing must be eliminated to ½ to 2 cycles (on 60-cycles basis) depending upon the size of the conductor and the arc amperes.

In explorations to develop the requisite equipment, short circuits were initiated on bare copper, covered copper and bare aluminum under typical stringing tensions. Thus for No. 1/0 covered stranded copper at 28-in. spacing and 550-lb. tension the conductor was found to part in 4 cycles with 8,000 amp., but in 28 cycles with 2,300 amp. at 5 kv. Tests on Nos. 6, 4 and 2 showed that extruction of the arc within one cycle leaves the conductor sufficiently strong to withstand normal service stresses. Two-cycle circuit clearances will adequately protect No. 1/0 copper with currents up to 7,000 amp. and No. 4/0 up to 10,000 amp., both typical maxima. Neither fuses nor conventional breakers offer the requisite speed of interruptions, so that effort is focussed on developments which will afford the necessary speed of clearing.

It appears that switchgear for ½-cycle fault clearance will be inexpensive. Single-phase switching will reduce outage. Sectionalizing can be increased to advantage by fusing more extensively, since the sections will not be cut off by transient faults. Also, an employee who creates an arcing fault would be less liable to serious injury with ½-cycle switching than with switching only after 10 to 40 cycles.

Standardization Moves

Again there was urging to promote acceptance of the new standard distribution transformers with interchangeable mounting. A. E. Silver (Ebasco Services) said the manufacturers reported they would be ready to take orders in July. Work will now be undertaken by the committee on 37½- to 100-kva. transformers (up to 15 kv.) and thus cover the whole range of pole-mounted transformers. Merrill De-Merit (West Penn) said manufacturers had proved gratifyingly cooperative in this work and many had relinquished "pet ideas" to permit the compromise result.

L. G. Smith in discussing crossarm specifications, now in tentative form, encountered strong sentiment in favor of requirements rigid enough to insure arm life equal to the 30-35-year

[*Continued on page 113*]

Dr. R. M. Burns, Bell Telephone Laboratories; I. T. Faucett, General Cable Co.; W. D. Sanderson, Detroit Edison Co.

G. T. Speer, Wisconsin Electric & Power; A. S. Brookes, Public Service Electric & Gas; C. W. Minard, Nebraska Power

Vaults for A.C. Secondary Networks — III

Vault Drainage, Venting, Clearances, Equipment Grounding

Survey reveals practice as to drainage, duct entrances, illumination, maintenance access, area of grate openings, grounding rods, explosion relief

JOHN S. PARSONS, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

AN EQUIPMENT opening must be provided in the roof of the vault of sufficient size to pass the largest piece of equipment which is to be installed with from 2 to 4 in. clearance on all sides. In some cases one of the vent openings may be used by removing its grating to get the equipment into and out of the vault. The more general practice, however, is to provide a separate equipment opening covered by one or more removable reinforced concrete slabs. These slabs must, of course, be of sufficient strength to carry safely the traffic which may pass over them. In the few cases where the data were given the sidewalk slabs were designed to carry a load of from 250 to 450 lb. per square foot and the roadway slabs were designed for loads of three to five times that much.

Access

Access to the vault for the purpose of operating and maintaining the equipment is provided either by hinging one of the vent gratings or a section of one of them or by a manhole opening, usually circular, covered by a solid manhole cover. The manhole opening may be located in the roof of the vault or in one of the removable concrete slabs. Where the arrangement of the equipment in the vault is such that it is possible to get complete access to it from one entrance, only one is provided. In many of the narrow vaults, however, it is not possible to get around the transformer from one end of the vault to the other and in these cases an entrance is provided at each end of the vault. Where the vault is divided by a wall into a transformer compartment and a protector compartment entrance must be provided into both compartments. There may be a grating covered opening in the roof of the protector compartment which serves as a ventilating opening, an equipment opening and an entrance for workmen.

In some cases no ventilation is provided in the protector compartment and in these vaults entrance is gained to the protector compartment through a manhole opening located in the roof proper or in a removable concrete slab over the equipment entrance. In a few vault designs, using two compartments with a wall between, both the transformer and protector are located in the transformer compartment and only the secondary bus and cables are located in the secondary compartment. The practice in regard to secondary compartment roof openings in these vaults is just the same as when the network protector is located in the secondary compartment.

Drainage

Galvanized iron or steel ladders are usually located under all vault openings provided for entering the vaults for operating and maintenance purposes. This is done as a matter of convenience and safety. In some cases the ladders are built into the walls of the vaults; however, the trend now seems to be to hold the ladders securely in place by means of removable brackets bolted to the vault walls.

It is necessary to dispose of the normal surface water which enters a vault through the vent gratings during and after every rain. This is done either by one or two drain connections from the vault floor to the sewer where possible, or by locating one or more sumps in the vault floor to collect the water which is pumped out of the vault, usually by a portable sump pump, but in a few cases by an automatic sump pump permanently installed in the vault and controlled by a float. A permanently installed pump can only be justified where frequent pumping is necessary to keep the vault reasonably dry, and possibly where traffic conditions make the use of a portable pump objectionable. The use of a sewer trap and drain is preferable to having to pump the water out of a vault; however, there is the possibility of the sewer backing up into the vault. Check valves are sometimes used in the sewer connections in an attempt to prevent reverse flow from the sewer to the vault.

The vault floor is sloped to the drain or sump. In some cases the floor is sloped to a trough running the full length of the vault adjacent to one of the sidewalls, and this trough drains to the sump. In other designs the section of the floor where the transformer sits is level and the remainder of the floor is sloped. The floor may slope from the level section to sumps or drains in both ends of the vault, or the floor on one side

of the level section may slope down to the level section and the floor on the other side of the level section slope in the same direction to the drain or sump.

When specified the slope of the vault floor for drainage to the sump or sewer drain varies from $\frac{1}{8}$ to $\frac{5}{8}$ in. per foot. Size of the pipe connection from the vault to the sewer varies from 4 to 7 in. in diameter. The design of sumps used varies greatly in shape and volume. The cross-section of the sump may be circular, square or rectangular and the volume varies from 0.025 to 2.06 cu.in. per square inch of vault floor area. Average sump capacity is 0.446 cu.in. per square inch of floor area drained. The majority of sumps have a concrete bottom, but in some dry locations the bottom of the sump is open to the earth and partly filled with crushed rock or gravel. In those vaults having both a transformer and a secondary compartment a sump or drain is usually provided in both compartments; however, in some cases all drainage facilities are omitted from the secondary compartment.

Grounding

Most vaults have ground rods passing down through the floor. The number of rods varies from two to six. Two rods is the usual number in a single-unit vault. Where the vault is divided into a transformer compartment and a secondary compartment there will usually be one or two rods in the transformer compartment and one in the secondary compartment. Copperweld rods are usually used. They vary in diameter from $\frac{5}{8}$ to 1 in. and in length from 5 to 20 ft. Rods project above the floor from 3 to 15 in. The projection most commonly used is 6 in. Ground rods are either connected directly to the secondary neutral of the system or to a ground bus in the vault, which, in turn, is connected to the system neutral. A ground bus is quite commonly used and generally consists of bare strap copper supported on one or more walls of the vault, and where a secondary bus is used the ground bus is often connected to the system neutral through a neutral bus suspended from the vault roof. In some cases either bare, weatherproof or flame-proof cable is used for the ground bus. For safety reasons it is common practice to connect all exposed metal parts, such as transformer tanks, protector housings, lead sheaths, ladders, steel conduits, etc., to the ground bus.

Equipment Arrangement, Clearances

For some years now there has been a very definite trend toward the use of three-phase network transformers, with the network protectors, either of the subway or open type, mounted on them. Mounting the network protector directly on the transformer eliminates considerable cable work in the vault, permits the use of a smaller vault and usually results in a less expensive installation. There is no experience to indicate that this practice increases the hazard to life or equipment over the practice of mounting the two associated pieces of equipment separately or even in separate compartments. With the network protector mounted directly on a three-phase network transformer the chances of a fault in the connections from the secondary windings of the transformer to the network protector are reduced to the minimum. This is the most dangerous location on the secondary part of the system for a fault to occur due to the difficulty of clearing it. It is often impossible to set the primary feeder breaker so that it will trip on a fault in this location, and if the fault is not self-clearing it will remain on the system until the transformer fails, and this failure may be accompanied by a serious fire or explosion.

All of the early network protectors were mounted on frameworks or vault walls separate from their associated transformers. Today the majority of protectors sold are for mounting on transformers; however, an appreciable number of protectors are purchased for separate mounting. These are used chiefly with single-phase transformers. Where the protector is mounted separate from the transformer bank care should be exercised to make the connections from the secondary windings of the transformer or transformers as near fault-proof as possible. Fireproof, braid-covered, varnished-cambric, insulated cables definitely spaced and supported by insulation cleats or spool type porcelain insulators are often used. In other cases rubber and braid, rubber and lead, paper and lead, and even strap copper connections, have been used.

The transformer or transformers should be located far enough from all vault walls to permit inspecting and painting the tank or tanks. Minimum clearance between the transformer or transformers and a vault wall in the vaults studied varies from 4 to 38 in. and the average minimum clearance is 12.1 in. Where single-phase transformers are used the clearance between transformers varies from 4 to 57 in., the average being 23 in. There should be sufficient clearance from the top of the equipment to the vault roof to permit properly training the cables when they connect to the top of the equipment and to allow any necessary work to be done in or around the top of the transformer. Minimum clearance between the top of the equipment and the vault roof varies from 10 to 60 in. and the average is 29.5 in.

Space should be allowed between the front of a subway network protector housing and other equipment or a vault wall so that the housing door can be opened and the protector rolled out on its rails to permit its being removed from the vault or worked on more easily. This requirement dictates that the minimum depth of the working space in front of a subway protector should not be less than about 30 in. Somewhat more than this minimum space is desirable to permit testing and maintaining the protector. Minimum depth of the working space provided in front of the protector varies from 28 to 71 in. and averages 45 in. Where the protector is mounted separate from the transformer on the vault wall it is usually so located that the bottom of its housing is about 24 in. above the vault floor. Lifting eyes are sometimes built into the vault roof to facilitate handling wall-mounted network protectors.

Duct Entrances and Cables

Ducts should enter the vault wall above the floor so as to reduce the possibility of water, which may accumulate in the vault, getting into the duct lines. Any water which gets into the ducts should drain to the vault, rather than have water flow from the vault into the duct lines. Duct entrances are often sealed with a sealing compound to keep vault water out of the ducts, and vice versa. Height above the floor at which the

[*Continued on page 106*]

Technique Developed for Fluorescent Lighting of Offices

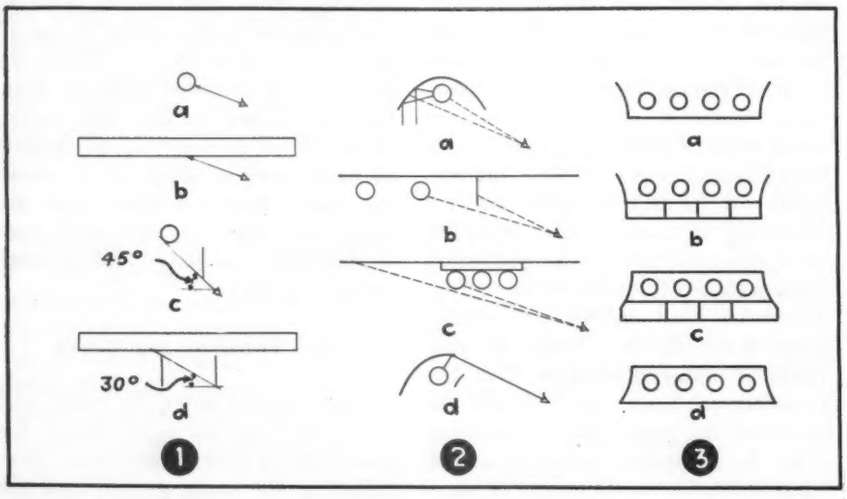
Design and application of luminaires with reference to shielding and glare, giving examples of calculations for average lighting intensity and spacing

W. G. DARLEY, General Electric Company*

AS NEW light sources are made available the development of application techniques must necessarily follow. Often the design of luminaires and systems for utilizing these sources, as in the case of the type H mercury lamps, falls within the scope of the practice which has developed to the time of the introduction of the new source. On the other hand, the new source may be so radically different from existing sources that it requires entirely new concepts in luminaires, permitting entirely different systems, solving old problems and creating new ones. Such an illuminant is the fluorescent lamp.

For instance, for many years the indirect system of lighting with a matte-white ceiling provided the near-ideal method of utilizing the concentrated extremely-bright tungsten-filament source for "lighting for seeing" —years when 20 ft.-candles of general lighting was something to talk about and 30 ft.-candles a *rara avis in terris*. Then the facts developed in the science of seeing raised our aim. We found that indirect lighting had a "ceiling"—literally as well as figuratively. To cost and maintenance, old objections, were added objectionable glare from the higher brightness of large areas in the normal field of view, the necessity for very heavy rewiring, objectionable quantities of radiant heat energy, and of sensible heat.

In dealing with the fluorescent lamp we will here concern ourselves only with the advantages and disadvantages of the lamps as they affect luminaire design for "lighting for seeing"; *e.g.*, for offices, schools, libraries and the like. The conclusions referred to herein have been reached subjectively and so may be altered as mass experience or objective data become available.



FIGS. 1, 2, 3—Shielding, glare and luminaire types

1. SHIELDING—The brightness of the fluorescent lamp varies from a maximum when the line of sight is normal to the axis of the lamp, to a minimum when the line of sight coincides with the axis of the lamp. For this reason it is felt that more shielding should be provided for viewing normal to the axis of the lamp than for viewing along the axis of the lamp.
2. GLARE—Various brightness contrast conditions which may result in glare.
3. LUMINAIRE TYPES—(a) Direct and direct-indirect with open top and diffusing bottom. (b) Direct-indirect—open top and open louvered bottom. (c) Direct, closed top and open louvered bottom. (d) Direct, opaque top.

Shielding

As a matter of habit (not a very good one possibly), we open our discussions of lighting systems with foot-candles. Undoubtedly it is desired to use the new illuminants to achieve the seeing levels which they make possible with comfort. Thus, the coverage per lamp must be limited to relatively small areas. Because of the wish to achieve the higher foot-candles, and because of the relatively low lumen output per foot of lamp, it seems desirable to utilize them in the most efficient method compatible with their limitations. This infers their use by direct and direct-indirect lighting methods.

While the source brightness of the fluorescent lamps, when compared to that of filament lamps, is but a glim-

*Nela Park Engineering Department, Cleveland, Ohio.

mer, it still rates high as a limitation to the indiscriminate use of fluorescent lamps for direct and direct-indirect lighting in seeing areas. It is felt, for instance, that the 1-in. (T-8) lamps should not be used in systems which permit direct specular reflections of the lamp by the work. On the other hand, for the majority of office tasks the brightness of the 1½-in. (T-12) lamp is judged to be tolerable from the standpoint of reflected brightness, particularly if foot-candles are high (50 ft.-candles and up)—drafting on near-horizontal boards may be one of the exceptions. At the same time the brightness of this lamp (T-12) is higher than we care to tolerate in the normal line of vision.

As is indicated in Fig. 1, however, there are two positions from which the lamp may be viewed—one at right angles to the axis (sketch a) and the other along the axis (sketch b). The brightness, and usually any glare effect, is at a maximum for viewing "a," less for viewing "b," the degree being reduced as the line of sight approaches coincidence with the lamp axis. Observation indicates that for right angle or normal viewing if the bare lamp is shielded to a 45-deg. angle, starting at the horizontal (sketch c), a good degree of comfort will prevail; that for viewing along the axis, a 30-deg. shielding angle is satisfactory (sketch d). These shielding media can be either opaque or translucent—if the latter, its brightness should be of a low order, depending somewhat upon the system. Of course, greater shielding than indicated should provide further freedom from the possibility of annoying direct glare.

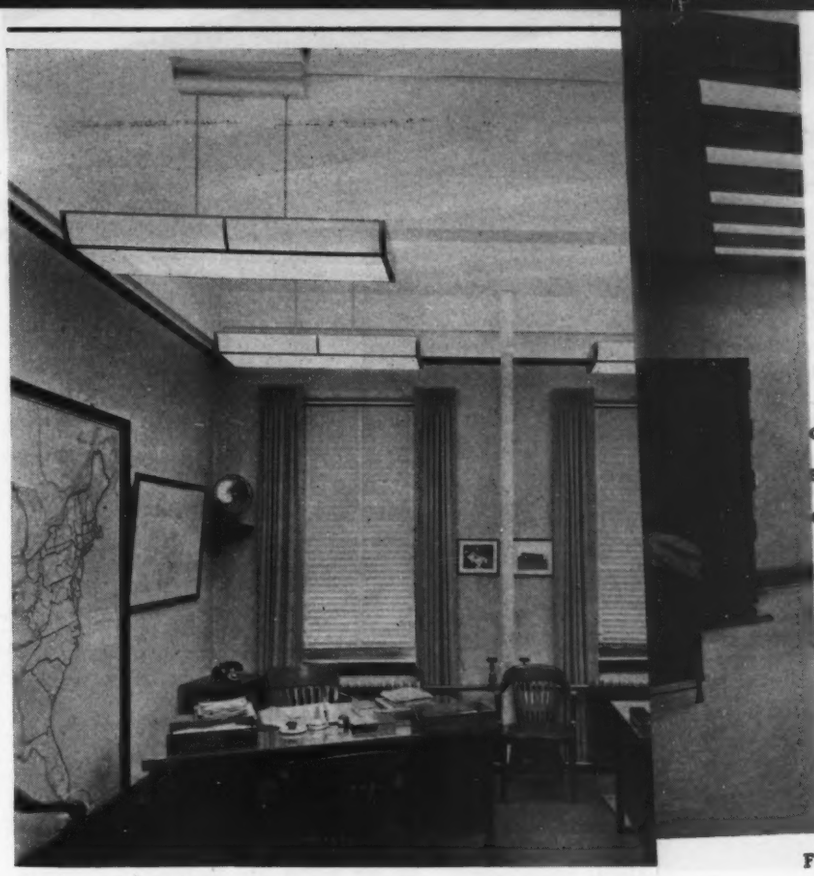


FIG. 4—DIRECT-INDIRECT—Six open-top louvered-bottom (direct-in with four 40-watt fluorescent white lamps, provide about 50 ft.-ca

Glare

Besides solving the problem of shielding the eyes from the source itself, consideration must be given to even more troublesome glare effects which can be caused by high brightness contrasts between lamps, reflectors and surroundings. For instance, sketch "a" in Fig. 2 illustrates the result of using one type of specular reflector without proper shielding—the lamp is seen against the dark metal. Sketch "b" shows the effect of mounting a unit at the ceiling with opaque and inadequate shielding—there is too great contrast between the lamp and the side of the unit. Diagram "c" points out one of the most obnoxious effects of bare lamps—the contrast between the lamps and the usually relatively dark ceiling beyond them. In addition to guarding against undesirable contrasts, care should be taken to so design units that they do not redirect the brightness of the lamp toward the eye, "d."

Application

Some of the basic ways of applying aforementioned restrictions, are illustrated in Fig. 3. They are:

1. Indirect, with open top and opaque or luminous sides and bottom (sketch a).

2. Direct-indirect, with open top and opaque or luminous sides and diffusing bottom (also illustrated by sketch a).

3. Direct-indirect, with open top, luminous sides and open louvered bottom (sketch b).

4. Direct, with closed top, luminous sides and open louvered bottom (sketch c).

5. Direct, with opaque top, otherwise more or less diffusing.

Naturally the single type of cross-section shown is not intended to cover the many forms it is possible for these various basic types to take.

After the luminaire is designed and made available, the must know how to a quires data which de acteristics of the unit producer. There are data can take: Table of utilization (lume tables giving actual tribution for vari heights (simplified method). With thes tions may be made ju for filament lamps—lumen" is, after all, r than a "filament lun there are four should be kept in r measure our comple installation:

1. The lumen rating lamps are given for th hours life. These pul are 5 to 10 per cent l initial outputs of the Thus, if illumination are made before the reached their rated would be higher than c

2. Lighting systems performance. Today, customer is buying ave illumination — not init tion of different fluore is probably comparabl similar filament systems

FIG. 5—TROFFERS—Continuous rows of louvered troffers on 3-ft. centers provide 45 ft.-candles with 40-watt fluorescent white lamps

3. Average-in-service illumination is the value which is calculated by the "lumen method." In practice, this figure is determined by taking foot-candle readings throughout the entire area and averaging them. It is often more convenient, however, to determine the illumination with one reading which may introduce considerable error. Measuring the light all over the room instead of, say, at the center of the room, is particularly important with some types of fluorescent lighting if a true average is to be obtained.

4. In measuring installations using fluorescent daylight lamps with cell type light meters it should be kept in mind that the most commonly used meters over-evaluate foot-candles obtained with daylight lamps. For instance, for the average General Electric meter the readings should be multiplied by 0.9 (reduced by 10 per cent).

Examples

Thus, it would be possible to design an office for 35 ft.-candles average-in-service using daylight lamps and yet read 81 ft.-candles with a light meter at some particular point when the installation was first turned on. To arrive at the 35-ft.-candle figure the following modifiers apply, assuming the lamp delivers rated lumens:

1. The reading at the center of the room was 81. The average reading was 58.

2. To obtain true foot-candles, 58 must be multiplied by 0.9 (meter correction) or 52 ft.-candles initial.

3. Average illumination at 100 hours (when lamps reach their rated figure) equals 52 $\times$ 0.90 (100-hour depreciation 10 per cent), or 47 ft.-candles.

4. Average - service illumination equals 47 $\times$ 0.75 (maintenance factor), or 35 ft.-candles.

Probably the principal difference in making illumination calculations for fluorescent lighting is that we do not have as flexible a type of source as we do have for filament lighting; *e.g.*, instead of determining the luminaire spacing and then selecting a suitable wattage filament lamp, for fluorescent we usually start with a fixed output and determine the spacing. For example, suppose we have an office 14½ x 17½ ft. (11-ft., 9-in. ceiling) which we wish to light to 50 ft.-candles with 40-watt fluorescent white lamps in four-lamp direct-indirect luminaires (louvered bottom):

Lamp output—2,120 lumens; 8,480 lumens generated per luminaire.

Luminaire output—70 per cent; 45 up, 25 down.

Co-efficient of utilization—0.34.

Maintenance factor (for semi-indirect lighting)—70 per cent.

$$\text{No. of units} = \frac{\text{Total Lumens Required}}{\text{No. Lumens Generated per Luminaire}}$$

$$\text{No. of units} = \frac{\text{Foot-candles} \times \text{Area in Square Feet}}{\text{Co-efficient of Utilization} \times \text{Maintenance Factor}}}{\text{No. Lumens Generated per Luminaire}}$$

$$\text{No. of units} = \frac{\frac{50 \times 250}{0.34 \times 0.70}}{8{,}480} = 6.2 \text{ and}$$

$$\frac{6}{6.2 \times 50} = 48 \text{ ft. candles}$$

Thus six units would give 48 ft.-candles average-in-service. The location of units would be largely a matter of choice. Fig. 4 illustrates one method in which this particular problem was solved.

Suppose we consider another case, that of a general office, 20 x 24 ft. (9-ft., 8-in. ceiling). The 50 ft.-candles desired are to be obtained with 40-watt fluorescent white lamps in single lamp louvered troffers mounted end to end.

Lamp output (also lumens generated per unit)—2,120 lumens.

Luminaire output—65 per cent, all down.

Co-efficient of utilization—0.46.

Maintenance factor (for direct lighting)—75 per cent.

$$\text{Spacing} = \frac{\text{Lumens Generated per Foot of Unit}}{\text{Lumens Required per Square Foot}}$$

$$\text{Spacing} = \frac{\text{Lumens Generated per Unit}}{\frac{4}{\text{Foot-candles}}}{\text{Co-efficient of Utilization} \times \text{Maintenance Factor}}$$

$$\text{Spacing} = \frac{\frac{2{,}120}{4}}{\frac{50}{0.43 \times 0.75}} = 3.4 \text{ ft.}$$

and $\frac{3.4}{3} \times 50 = 57$ ft. candles

or $\frac{3.4}{3.75} \times 50 = 45$ ft.-candles

Thus continuous (wall to wall) rows of troffers installed on 3-ft. centers would give 57 ft.-candles average in service. Practical considerations, however, will often prevent the units from being installed across the full width of the room. This happened in the actual installation above figured, shown in Fig. 5. In this case it was possible to install only four 4-ft. lamps across the (almost) 20-ft. width, thus reducing the troffer area by 20 per cent. Since a 3-ft. spacing is above calculated to give 57 ft.-candles, a spacing of (in effect) 3.75 ft. (3/0.8) would give about 45 ft.-candles average in service. Measurements of the installation check these figures.

What, Where and How of the New Building Wires

Admission into the new National Electrical Code of conductors covered with new insulations raises questions as to the uses and applicability of these wires — Here are comprehensive answers

E. A. BRAND, N.F.P.A. Electrical Committee

NUMBER 14 will carry 15 amperes, No. 6 is good for 50 amperes, 500,000 circ.mil will carry 400 amperes —every designer, estimator and wireman knows this story. But no more; that was prior to the 1940 National Electrical Code. Now No. 14 may be limited in capacity to 6 amperes or to 31 amperes, depending on how it is installed and the type of insulation used. We must change our ideas on design radically.

Recognizes Developments

In effect, the new Code will recognize the technological developments in insulation that have taken place during the past years, together with results of manufacturers' research on current-carrying capacities, and will make the following basic changes in requirements for building wires and cables:

1. It will recognize rubber insulations suitable for operation at maximum temperatures of 50 deg. C., 60 deg. C. and 75 deg. C. and will increase current-carrying capacities of a given size copper accordingly, depending on the insulation used.

2. It will recognize that wires installed in raceways or cable assemblies do not dissipate heat as rapidly as do wires installed in "free air." Hence, current-carrying capacities for a given size conductor are increased for open work and knob-and-tube, since more current is required to bring the conductor insulation to the rated maximum temperature.

3. It will recognize that a high ambient temperature of the surroundings effectively reduces the current flow necessary to bring the insulation to the maximum operating temperature. Normally, current-carrying capacities are based on 30 deg. C. (86 deg. F.). If higher ambient temperatures are encountered, capacities are reduced accordingly.

5. It will recognize specific results of chemical research in quality improvement and in types of insulations. Hence, it will require less insulation than formerly on several types of conductors and will recognize two new types of insulation. One of these is other than rubber.

6. The Code will recognize that conduit space in existing buildings is at a premium; hence will make special provisions for rewiring.

(a) Three types of thin-wall insulated conductors are approved for rewiring only.

(b) An increase in conduit fill is permitted for rewiring only.

Downward Revision

The above six points consider only conductors for general purposes, comparable to those of column A, Table I of the 1937 Code. The general effect of the changes is a downward revision of capacities, which, in many cases, makes larger conductor sizes necessary. This will be particularly pronounced in large feeder and service work.

The logical result is that design becomes more complicated. Many factors must be considered after the ampere loading of the conductors has been determined. Voltage drop is not covered by the code, although this, as always, must be the basic consideration in design. Its effect is to reduce sharply the value of the increased temperature limits permitted and the increased loading possible in the smaller conductors, since loads must be held below the maximum for satisfactory operation.

Special conductors, as asbestos or varnished cambric insulated types, are not considered in this discussion. There is a whole new array of these, with varying operating temperatures up to a maximum of 200 deg. C.

Naturally, such radical changes produce many questions at the outset. Following are some that have been asked the writer from time to time:

1. (Q) What will be the conductors for general building work both for new installations and rewiring?

(A) These are indicated in Table I. Three old friends will be recognized: Code wire, still known as type R; the 30 per cent or performance grade with a new temperature rating of 60 deg. C., known as RP, and the heat-resistant or superaging grade with a temperature rating of 75 deg. C., known as RH. In addition, there are four types of thin-wall insulated conductors made in a limited size range. One of these, RHT ("T" for thin-wall), may be used either for new construction or for rewiring of existing raceways. The other three types are limited to rewiring in existing raceways.

2. (Q) In what sizes will the conductors be manufactured?

(A) Code wire (R), 30 per cent (RP), and heat resistant (RH) will be made in the complete size range, as before; synthetic thin-wall (SN) in sizes 14 to 4/0; latex (RU) and performance grade (RPT) thin-wall in sizes 14 to 10; heat-resistant

Table I—Conductors for General Use in Building Wiring and Rewiring—1940 N.E. Code

Commonly Known as	Type Letter	Max Operating Temperature Deg. C.	Deg. F.	Insulation	Covering*	Size Range	Thickness of Insulation
New Wiring and Rewiring—No Change from 1937 Code conduit fills							
Code wire	R	50	122	Code grade rubber	M–R, F–R*..	Complete range..	Same as 1937 Code
30 per cent or performance grade..	RP	60	140	Performance grade rubber	M–R, F–R*..	Complete range..	Same as 1937 Code
Heat resistant or super-aging grade.	RH	75	167	Heat-resistant rubber	M–R, F–R*..	Complete range..	Same as 1937 Code
New Wiring and Rewiring—Increased fill for rewiring of existing raceways only							
Heat-resistant thin wall	RHT†	75	167	Heat-resistant rubber	M–R, F–R...	14 to 8	14 to 10 = 2/64″ (0.0312″) 8 = 3/64″ (0.0468″)
Rewiring of existing raceways only—Increased fill permitted							
Performance thin-wall	RPT	60	140	Performance grade rubber	M–R, F–R...	14 to 10	2/64″ (0.0312″)
Latex thin-wall	RU	60	140	Latex rubber	M–R, F–R...	14 to 10	18 mils (0.018″)
Synthetic thin-wall	SN	60	140	Solid synthetic	None	14 to 4/0	14–10 = 2/64″ 8 = 3/64″ 6–2 = 4/64″ 1–4/0 = 5/64″

* Moisture-resistant, flame-retardant. † No change from 1937 Code conduit fill Table II when used for new work.

Table II—Maximum Number of Conductors No. 14 to No. 18 in ½ and ¾ In. Conduits

Conductor	Type Letter	New Work								Rewiring Existing Raceways							
		½-In. Conduit				¾-In. Conduit				½-In. Conduit				¾-In. Conduit			
		14	12	10	8	14	12	10	8	14	12	10	8	14	12	10	8
Code wire	R	4	3	1	1	7	5	4	2	4	3	1	1	7	5	4	2
30 per cent performance..	RP	4	3	1	1	7	5	4	2	4	3	1	1	7	5	4	2
Heat-resistant	RH	4	3	1	1	7	5	4	2	4	3	1	1	7	5	4	2
Heat-resistant thin-wall..	RHT	4	3	1	1	7	5	4	2	7	5	4	2	9	9	8	4
Performance thin-wall	RPT									7	5	4	*	9	9	8	*
Latex thin-wall	RU	Not recognized for new work								9	8	6	*	9	9	9	*
Synthetic thin-wall	SN									9	8	6	3	9	9	9	6

* Not recognized in No. 8 size. NOTE — Above table varies in some respects from Tables VI and VII of galley proof of 1940 Code, but is in accordance with later information received from secretary of NFPA electrical committee.

Table III—Factors for Determining Allowable Current-Carrying Capacity of Conductors in One Raceway or Cable at Various Ambient Temperatures

Ambient Temperature		Type R, 50 Deg. C			Types RP, RPT, RU, SN, 60 Deg. C			Types RH, RHT, 75 Deg. C		
		Number of Conductors			Number of Conductors			Number of Conductors		
Deg. C	Deg. F	1 to 3	4 to 6	7 to 9	1 to 3	4 to 6	7 to 9	1 to 3	4 to 6	7 to 9
30	86	1.00	0.800	0.700	1.00	0.800	0.700	1.00	0.800	0.700
40	104	0.71	0.568	0.497	0.82	0.656	0.574	0.88	0.704	0.616
45	113	0.50	0.400	0.350	0.71	0.568	0.497	0.82	0.656	0.574
50	122	0.00	0.000	0.000	0.58	0.464	0.406	0.75	0.600	0.525
55	131				0.41	0.328	0.287	0.67	0.536	0.469
60	140				0.000	0.000	0.000	0.58	0.464	0.406
70	158							0.35	0.280	0.245
75	167							0.000	0.000	0.000

For permissible current-carrying capacity at given ambient temperature and given number of conductors in one raceway or cable, multiply value shown in Table I, Ch. 10, 1940 N.E.C., for type and size of wire in question, by factor shown in table. For instance, what is carrying capacity of No. 4/0 type RP at 45 deg. C. ambient, with two three-wire, one-phase circuits in conduit? Answer: Two three-wire, one-phase circuits include four conductors normally carrying current, hence under type RP, four to six conductors, find 0.568 opposite 45 deg. C. Capacity from Table I is 193 amp. 193 × 0.568 = 110 amp.

thin-wall (RHT) in sizes 14 to 8. It is understood that some manufacturers are prepared to supply thin-walls other than synthetic or latex in larger sizes than those indicated on special order.

3. (Q) What is the price differential between types?

(A) This can best be answered by quoting a manufacturer's advertisement appearing in the April issue of a trade paper.* If No. 14 Code wire carries a price of $1, it is stated that the price of No. 14 of other types will be roughly in accordance with the following:

60 deg. C. performance RP	1.37
75 deg. C. heat-resistant RH	1.63
75 deg. C. heat-resistant thin-wall RHT	1.62
60 deg. C. latex thin-wall RU	2.00
60 deg. C. synthetic thin-wall SN	3.45

It is understood that 60 deg. C. performance thin-wall RPT is not yet in production. It is reasonable to expect these differentials to narrow as production of the new conductors increases.

4. (Q) Where can and where cannot these conductors be used?

(A) The three old friends (R, RP, RH), made in a full range of sizes, can be used either for rewiring or for new construction. So can the 75 deg. C. heat-resistant thin-wall RHT. The other thin-walls—performance grade (RPT), latex (RU) and synthetic (SN), are limited to the rewiring of existing raceways, where space is not available for conductors with full thickness insulation, and where it is impractical to increase the size of the raceway due to structural conditions.

5. (Q) What are the differences in permissible conduit fill between new construction and rewiring?

(A) No change has been made in conduit fills permitted for new construction, regardless of the type of conductor used. Table II of the 1937 Code still governs. For rewiring of existing raceways, as in 4 above, when any of the four thin-wall insulated conductors are used, fills may be in accordance with the following:

One conductor per raceway — 60 per cent fill

Two conductors per raceway — 40 per cent fill

Three or more conductors per raceway — 50 per cent fill

*Since the above comparisons were printed there have been several price changes. Prices current on May 1 showed the following ratios using No. 14 type R as $1: RP—1.52, RH—1.81, RHT—1.80, RO—2.45, SN—3.45.

These fills are shown in Table II for sizes 14 to 8 in ½-in. and ¾-in. conduit, as commonly used on branch circuits.

6. *(Q) Why should conductors installed in "free air" be permitted to carry more current than those of the same size installed in raceways or cable?*

(A) The maximum temperature reached by the insulation is dependent on the rate at which the heat resulting from current flowing through the copper is dissipated. Manufacturers' investigation showed that there is greater dissipation of this heat in free air than in the confined space of a raceway or cable; hence greater currents can be carried without exceeding the safe operating temperature of the insulation.

7. *(Q) What effect does ambient temperature have on current-carrying capacity?*

(A) The new Code tables are based on an ambient of 30 deg. C. Using 50 deg. C. wire as an example, the maximum permissible current will raise the insulation temperature 20 deg. more, to the limit of 50 deg. With higher normal room temperatures, capacities are radically reduced as smaller currents will result in the maximum permitted operating temperature of the insulation. Hence, either larger or more expensive conductors than before will have to be used where ambients are high.

8. *(Q) What effect do the number of conductors in a conduit have on current-carrying capacity?*

(A) The 1940 Code tables are based on the heat dissipation of not more than three conductors in a raceway or cable. Due to more heat in a confined space as the number of conductors is increased, current-carrying capacities are reduced to 80 per cent if there are four, five or six in a raceway, and to 70 per cent if there are seven, eight or nine. Otherwise the allowable temperature of the insulation would be exceeded. The neutral conductor in normally balanced circuits is not included in counting conductors. For instance, three three-wire, one-phase circuits would be considered as six conductors. Table III indicates single factors that may be used for determining the allowable capacity of conductors in raceway or cable at various ambient temperatures. Table IV gives an example of the effect of the restrictions on No. 12, 60 deg. C. wire. The wide range is to be noted.

9. *(Q) The various factors used result in odd numbers of permissible amperes. How will the conductors be fused?*

(A) The next larger standard size is permissible if this is not more than 50 per cent above the conductor rating. If in excess of 50 per cent of the rating, the next smaller size fuse must be used.

10. *(Q) How can the installer and inspector identify all these grades of wire in the field?*

(A) All rubber-insulated conductors will have a continuous marking printed on the braid. This will include the type, as R, RHT, etc., the size and manufacturer. It is not required on synthetic coverings.

11. *(Q) How do the conductor insulators compare in aging characteristics?*

(A) Underwriters' Laboratories and manufacturers both base their evaluation of aging characteristics largely on accelerated tests. Two devices commonly used are an oxygen bomb at 300 lb. per square inch pressure and at elevated temperatures, and an oven at atmospheric pressure and elevated temperatures. Insulations must retain their characteristics after periods of two to seven days of such accelerated tests. Those that do not age well will become brittle or soft, losing their tensile strength and elasticity.

Table V gives the U.L. tensile strength test requirements now in force for Code grade, 30 per cent, and heat-resistant rubbers, as well as those proposed for the four thin-walls. It is understood the latter have not yet been officially adopted. It will be noted that after 96 hours in the oxygen bomb the minimum final tensile strength for latex thin-wall is 4½ times the minimum initial tensile strength of type R insulation. The new insulations show up much better on aging tests than type R ever did.

12. *(Q) What are the advantages of the different insulations with their outer coverings?*

All assemblies are flame-resistant and moisture-retardant and are obtainable in various colors. In addition: Type R—Low price. Type RP—A somewhat better grade rubber that can be operated at a 20 per cent higher temperature than type R without deterioration. Better aging characteristics. Type RH—High quality rubber, heat resistant without harmful deterioration over long periods of time; 50 per cent higher operating temperature than type R; best of the standard rubbers for new construction. Type RPT and RHT—$\frac{1}{64}$-in. less insulation than RP and RH, hence take less space in rewiring than do R, RP and RH. Otherwise same in general as RP and RH. Type RU, very thin insulation due to extra high quality of latex rubber; smallest over-all diameter of any rubber insulated wire; meets the most severe bomb test requirements of any rubber; due to smaller over-all diameter, require less conduit space in rewiring than do RPT and RHT. Type SN, $\frac{1}{64}$-in. less insulation than R, RP, RH in small sizes, but no braid required, hence comparable in over-all diameter to type RU; oil, mild acid and alkali resistant; has low moisture absorption; due to smaller over-all diameter, require less conduit space in rewiring than do RPT and RHT; available in wider size range than other thin-walls.

13. *(Q) Who makes the various conductors?*

(A) All except latex type RU are made by most of the larger, reputable manufac-

Table IV—Example of Effect of Ambient Temperature and Number of Conductors No. 12 Type RP, RPT, SN, RU in One Raceway or Cable on Current-Carrying Capacity

Ambient Temp. and Rating Factor	Current-Carrying Capacity Permitted			
	In Free Air	In One Raceway or Cable		
		1-3 Conductors 100%	4-6 Conductors 80%	7 to 9 Conductors 70%
30° C.— 100%	31 amp.	23 amp.	18 amp.	16 amp.
40° C.— 82%	25 amp.	19 amp.	15 amp.	13 amp.
45° C.— 71%	22 amp.	16 amp.	13 amp.	11 amp.
50° C.— 58%	18 amp.	13 amp.	10 amp.	9 amp.
55° C.— 41%	13 amp.	9 amp.	7 amp.	6 amp.
60° C.— 0	0	0	0	0

Table V—Underwriters' Laboratories Aging Test Requirements for Building Wires

Conductor Type Letter	Max. Op. Temp.	Minimum Initial Tensile Strength lb./sq.in.	Oxygen Bomb Requirements (300 lb./sq.in. pressure)				Geer Air Oven Test Requirements			
			Bomb Temp.	Hours in Bomb	Permissible Reduction in Tensile	Final Tensile Acceptable	Oven Temp.	Hours in Oven	Permissible Reduction in Tensile — %	Final Tensile Acceptable
Present Requirements										
R	50° C.	500	70° C.	48	40%	300 lb.	70° C.	168	40%	300 lb.
RP	60° C.	1,200	70° C.	96	25%	900 lb.	70° C.	96	15%	1,020 lb.
RH	75° C.	1,500	80° C.	168	25%	1,125 lb.	120° C.	120	50%*	1,000 lb.
Requirements Proposed for Thin-walls										
RPT	60° C.	1,200	70° C.	96	25%	900 lb.	70° C.	96	15%	1,020 lb.
RHT	75° C.	1,500	80° C.	168	25%	1,125 lb.	120° C.	120	50%*	1,000 lb.
RU	60° C.	3,000	70° C.	96	25%	2,250 lb.	70° C.	96	15%	2,550 lb.
SN	60° C.	1,500	Not required				120° C.	120	25%	1,125 lb.

* Not less than 1,000 lb./sq.in. final tensile.

turers. Type RU is now available from U. S. Rubber Company, Simplex Wire & Cable Company and National Electric Products Company. It is understood that other manufacturers may soon be in a position to manufacture this material.

Gossip Column

14. (Q) It is whispered about synthetics that they (a) Become hard and brittle at low temperatures. (b) Become soft at high temperatures. (c) Are subject to cold flow. (d) Become hard and brittle if operated for long at high temperatures because the plasticizers are driven off.

(A) Synthetics are thermoplastics. Hence their characteristics are subject to variation with changes in temperature. If they do not alter appreciably within the temperature range approved by the 1940 Code, this factor should not be troublesome.

Underwriters' Laboratories test report Electrical No. 11352 of September, 1939, satisfactorily covered all four points listed above. Synthetics do stiffen at temperatures below freezing and the insulation will crack off if the wire is whacked against a floor to straighten it at such low temperatures; so will the finish of rubber-covered conductors if treated in the same way at low temperatures. The proposed U.L. tests include bending six turns of each size conductor around a mandrel at —10 deg. C. If the synthetic cracks, the wire is rejected. The 1940 Code will carry a caution: "Synthetic insulation may stiffen at temperatures below freezing and care should be used in its installation at these temperatures."

The second and fourth points above are answered by the oxygen bomb and air oven tests reported in Electrical No. 11352. After 96 hours in the oxygen bomb at 70 deg. C. and after 62 days in the oven at 60 deg. C. the synthetic showed no loss in tensile strength and only a slight loss in stretch recovery. This severe test would have indicated if there were a tendency for long operation at elevated temperatures to cause either brittleness or softness of the insulation.

Both synthetics and rubber insulations are subject to cold flow. This characteristic is more pronounced in the synthetics, but the test report indicates it is not so great as to destroy the value of the product as an insulation. All of the above points will be covered in the Underwriters' Laboratories proposed test requirements.

15. (Q) It is whispered about latex insulation that: (a) It is impossible to get enough anti-oxidants into the insulation to prevent aging. (b) It is hard to strip. (c) If the braid is removed there is no protection against oxidation from light and heat around the connections.

(A) The first point is covered in Electrical Testing Laboratories' report No. 150223 made for the manufacturers of latex insulated wires and presented to the electrical committee last December. After 96 hours of accelerated aging in the oxygen bomb at 70 deg. C. the insulation showed a depreciation of 4.7 per cent in tensile strength and 1.25 per cent in elongation. This compares with a permissible depreciation of 40 per cent in Code wire tensile after 48 hours in the bomb.

Latex insulated fire alarm cables have been used for some years. Specification No. 16 of the International Municipal Signal Association covering this insulation requires: Minimum initial tensile, 3,500 lb. per square inch. Minimum initial elongation, 650 per cent at rupture. After 96 hours in the oxygen bomb, required tensile 3,200 lb.; required elongation 600 per cent. After 168 hours in the oxygen bomb, required tensile 300 lb.; required elongation 550 per cent. This is a better record than any other rubber insulation can show on test.

There have been field complaints on hard stripping. The writer encountered it on wire supplied several years ago. However, on a job he supervised recently the contractor making the installation encountered no trouble. His comment was that the insulation cut like rubber bands—it was so tough and stretchy. It required a sharp knife, but it did strip clean. Several hundred million feet of latex insulated wires and cable have been installed to date.

The third objection seems somewhat silly. Latex insulated conductors are approved for conduit or raceway work only; hence the wires are not exposed to light. If the installation is properly made, the temperature to which the insulation is exposed will not exceed 60 deg. C., for which it is designed. The braid is not intended to protect the insulation from heat, but from mechanical damage during handling and installation.

Use of the Conductors

16. (Q) What will be the effect on rewiring costs of price differentials between the various types of conductors?

(A) Practically none in the mind of the customer. He compares rewiring cost using thin-wall conductors and existing raceways with the alternative of channeling plaster and concrete, installing new conduits, replastering, repainting, clearing plaster dust off everything, together with the disruption in normal use of the area being rewired. The next alternative is new exposed work. Rewiring with thin-wall insulated conductors, even with the highest priced ones, results in a job that is reasonable in cost in comparison with the other methods.

17. (Q) What is the practical effect of reducing the current-carrying capacities when wires are to be used in high ambient temperatures?

(A) This means either that wires with higher quality insulations operable at higher temperatures must be used to keep the wire size down or larger conductors and conduits must be installed in places such as boiler rooms, high temperature sections of industrial plants, and other locations with a normal temperature of 40 deg. C. (104 deg. F.) and up. For instance, to carry 20 amp. in conduit at 45 deg. C. ambient will require No. 6 Code wire, No. 10 performance grade or No. 12 heat-resistant grade. No. 12 RH sounds good, but do not forget voltage drop. If the design calls for not over 2 per cent drop and it is a 115-volt circuit, No. 10 is limited to a 56-ft. run and No. 12 to a 36-ft. run. Hence voltage drop may become the deciding factor.

18. (Q) Will the higher temperature ratings (and increased capacities) of certain conductors result in a higher wattage loading for a given size wire than is now the practice?

(A) Yes, if voltage drop is neglected; no, in most cases, if voltage drop and the performance of equipment served is considered in design. On lighting circuits limited to 2 per cent drop, the higher capacities will be of little help except for short runs; on motors where 5 per cent regulation may be permitted smaller conductors may frequently be used to carry a given load.

19. (Q) How does voltage drop enter into wire size calculations?

(A) It must be the governing factor and will continue to determine sizes in most cases. On simple circuits, the higher permitted capacity usually is of no value, except where voltage drop is negligible. Assume a 2,500-watt, 115-volt, two-wire circuit and a run of 50 ft. to the load center. The current is 21.7, say 22 amp. Following are wires that could be used:

Wire	Size	Capacity 1-3-in conduit Amp.	Voltage Drop* Volts	Percentage
75° C.— RH, RHT....	14	22	5.8	5.04
60° C.—RP, RPT, SN, RU	12	23	3.5	3.02
50° C.—R	10	25	2.25	1.95

*Based on usual method of calculation

Neglecting voltage drop, No. 14 heat-resistant wire can be used; considering voltage drop for lighting circuits, a No. 10 conductor must be used. Where current-carrying capacity is radically reduced by the 1940 Code, due to high ambient temperature or more than three wires carrying current in one raceway or cable, the Code *may* automatically make some provision for voltage drop without intending to do so by requiring larger conductor sizes than the 1937 Code calls for. This must be determined in each case. For example, assume that a 50-ft. run of three three-wire, 115-230-volt, single-phase circuits, each carrying a balanced load of 5,000 watts, is to be installed in ¾-in. conduit on rewiring. The three circuits include six "hot" conductors, each carrying 22 amp. at 230 volts. A 2 per cent drop is permitted, which according to normal methods of determination requires No. 12 wire as the minimum. The Code would call for No. 12 heat-resistant grade (RHT) or No. 10 performance grade (RPT, RU, SN) or No. 8 Code grade (R). It should be noted that if there were not more than

[*Continued on page 112*]

Activated Alumina Holds Quality in Insulating Oil

Single process suffices for maintaining apparatus oils of large plant at appropriate dielectric strength, power factor and neutralization number by removing moisture, sludge, acid

J. ELMER HOUSLEY, Aluminum Company of America, Alcoa, Tenn.*

DETERIORATION of insulating oil may be prevented by the use of activated alumina. Contamination of oil resulting from the entrance of moisture during the breathing cycle is satisfactorily stopped by the use of the same material.

Experienced gained at the Alcoa operations of the Aluminum Company of America during the past seven years has led to the adoption of activated alumina as the exclusive agent for the maintenance of all oil used in electrical equipment wherever the oil shows any evidence of deterioration. All oil in service is subjected to periodic tests for neutralization number, dielectric strength and power factor. The oil is maintained free of acid and sludge by contact between the oil and the activated alumina. Moisture is both removed and prevented from reaching the oil, or interior of oil containers, by the application of a breather filled with activated alumina. In small accessories, such as bushings, both water and acid are removed by contact with a small quantity of the material.

By means of thorough trial and extensive tests under the supervision of competent chemists the method of applying activated alumina to transformers, oil storage tanks and bushings has been developed to fit in with the usual maintenance methods employed for either major or isolated plants and substations. The results confirm the adequacy of activated alumina for controlling all oxidation and moisture problems which have been troublesome on the large power system at Alcoa during the past 25 years.

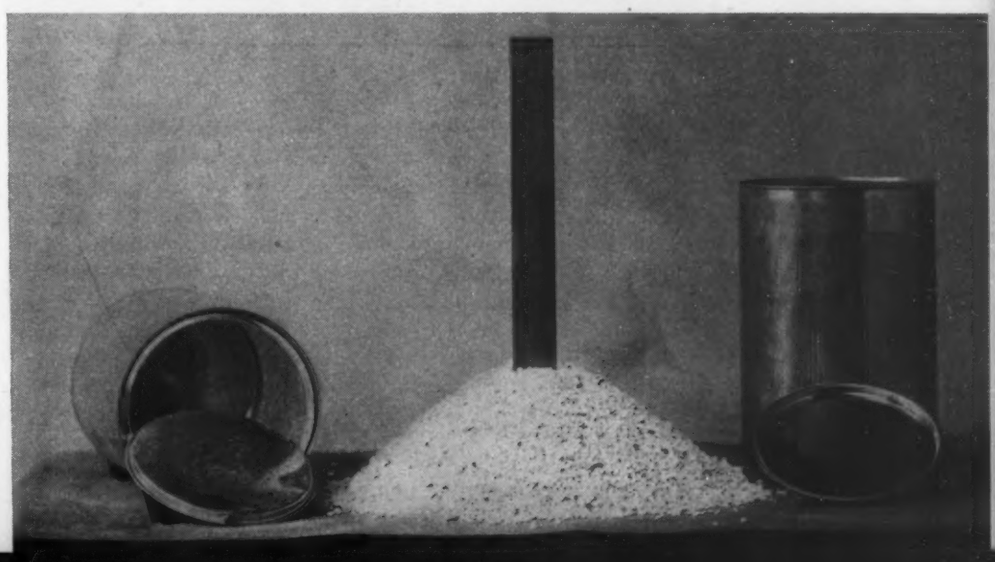
*Superintendent of Power.

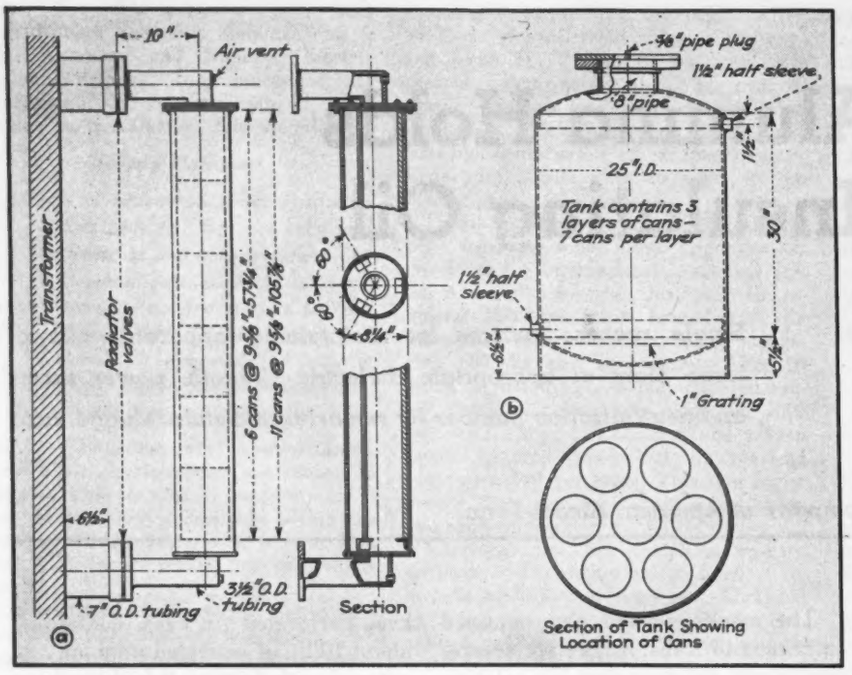
The results desired and obtained in regard to transformers are several and must be discussed in relation to design. Transformers without conservators or inert gas over oil present the most serious problem, because within a five- to twelve-year period the windings and cooling surface become coated with sludge, which progressively reduces the capacity of the transformers. The initial program consists of removing the sludge from the winding, core and tank; while this is being done the oil is freed of sludge and water by filtration through the usual blotter press or centrifuge. On its return to the transformer the oil passes through a bed of Grade A, 4 to 8 mesh, activated alumina. Simultaneously the transformer is fitted with an external tank or cylinder filled with 60 to 200 lb. of the same size activated alumina. The amount of material used depends largely on the size of the transformer; the figures given cover transformers ranging in size from 500 to 15,000 kva. Perforated tin cans, containing about 10 lb. of activated alumina and covered with friction lids, have been adopted lately for package containers.

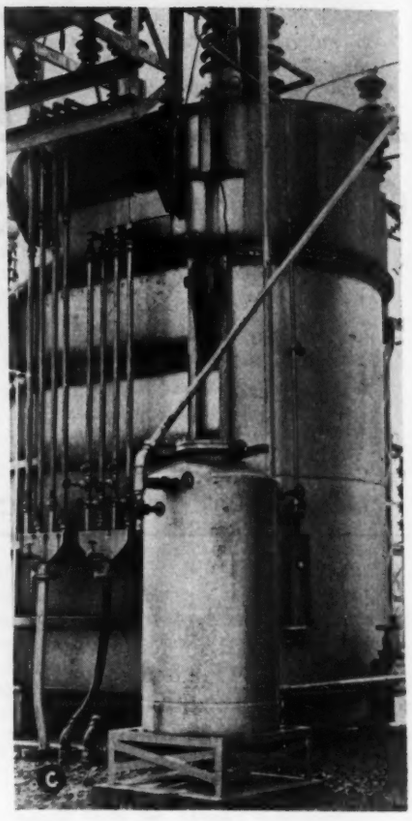
Circulation of oil through the material is maintained by thermo-syphon action. The external tanks are connected to the transformers by pipes which make a loop from the oil in the top of the tank to the oil in the bottom. The material is changed at intervals of two to three weeks until the acidity is reduced to a neutralization number near 0.1; afterward the material is changed whenever the neutralization number rises to 0.2. The amount of material selected is sufficient usually to last one year between changes. Design data will be found in the April, 1939, Transaction Section of *Electrical Engineering*.

In order to reduce the moisture content of the oil and to prevent the entrance of additional moisture by breathing, in the type of transformer

PERFORATED TIN CANS hold 10 lb. of activated alumina—These filled cans are stacked or nested in tanks or cylinders attached to transformers as in the other illustrations

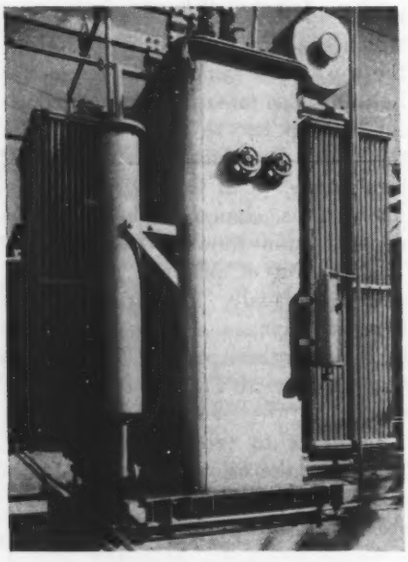






TANKS OR CYLINDERS circulate the oil through the activated alumina by thermo-syphon action

(a) Long cylinders hold single column of eight or eleven cans.
(b) Shorter cylinders hold three layers of seven cans per layer.
(c) Thermo-syphon treater on 14,000-kva. transformer.



THERMO-SYPHON TREATER (left) and breather (right) applied to 4,000-kva. transformer

under discussion, a breather is attached. The breather contains 20 lb. of Grade E, 8 to 14 mesh, activated alumina. This material has the physical appearance of porcelain and does not change its physical structure whether saturated or dry. Moisture adsorption is indicated by a change in color through chemical means incorporated in the Grade E material. Moisture will actually condense within the first inch layer of material, thereby increasing the effectiveness of this breather. The water so condensed is harmlessly drained to the atmosphere through the opening at the bottom of the breather. None of the breathers installed during the past four years has required reactivation of material since they have been in service. The dielectric strength of the oil has been held at, or over, 30,000 volts, which is the maximum capacity of the dielectric test apparatus. Reactivation is accomplished by placing the activated alumina on a screen and heating it in a ventilated electric oven at 400 to 500 deg. F. for about four hours. A change of color from pink to blue indicates the removal of adsorbed moisture. The same type breather is applied to oil storage tanks and to containers in which switch sticks and wood members of live line tools are housed.

Oil-filled Bushings

The oil in oil-filled bushings is protected from oxidation and moisture by the use of a canvas sack filled with 3 lb. of Grade A, 4 to 8 mesh, activated alumina. This sack is coiled in horseshoe shape in the gauge glasses of 150-161-kv. bushings. New material which has not been oil soaked is used in order to secure a maximum adsorption of moisture, about 12-14 per cent of its own weight.

All new transformers are ordered equipped at the factory with the thermosyphon treaters and breathers. Recent designs of transformers in the larger sizes reduce the rate of oxidation and the amount of moisture introduced by restricting the amount of air which is in contact with the oil. The amount of activated alumina needed for preventive treatment is directly proportional to the rate of oxidation of the oil. A wide variation in the rate of oxidation may be caused by variations in the quality of oil as purchased.

Since 1932 oil in transformers aggregating 320,000 kva. in capacity has been restored to a low neutralization number; these transformers have been equipped with thermo-syphon treaters for maintaining the acidity at a low level of not over 0.20 neutralization number. A group of transformers of approximately the same total capacity is now being equipped with treaters. In this group treaters are being applied before the acidity reaches a neutralization number of 0.40, in order to stop deterioration of the oil prior to the formation of sludge.

For some four to five years oil-filled bushings have been equipped with sacks containing activated

alumina; the material has been replaced with new every two years. The neutralization number has been maintained at not over 0.10 and the breakdown point at 28,000 volts or over. Previously the oil in these bushings was changed every four years in order to prevent sludge formation and the occurrence of dangerously low dielectric strength of oil.

The volume of work involved in the future, now that all of the badly sludged equipment has been cleaned and the high acidity oil reduced to a low level, consists of the annual removal of 10,000 lb. of activated alumina for reactivation. This is the amount of material used for the maintenance of 320,000 kva. of transformers containing 100,000 gal. of oil. This group contains equipment 15 to 25 years old. The volume of work and the cost of maintaining the oil in equipment of more recent design will be 75 per cent lower than that of the old group.

Oil Lost and Process Costs

Oil required to replace the oil lost annually in the reactivation process amounts to about 400 gal. for the old group of 320,000 kva. The loss is approximately 0.04 of a gallon per pound of activated alumina.

The following table indicates the cost in cents per gallon of oil per year for the maintenance of oil at low acidity as experienced at Alcoa; the severe service group is composed of transformers which formerly exhibited heavy sludge deposits in five to ten years; the light service group contains transformers which exhibited an oxidation rate resulting in heavy sludge accumulation within an eleven to twenty-year period:

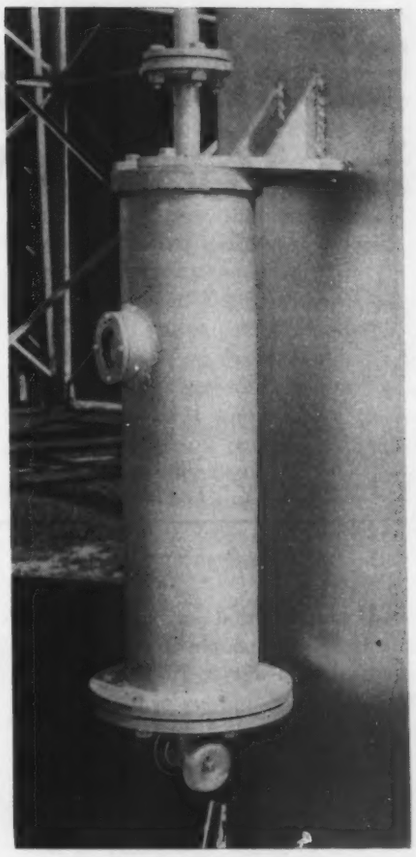
	Cost in Cents per Gallon of Oil, per Year	
Fixed Charges	Severe Service	Light Service
Thermo-syphons	$0.0045	$0.0045
Activated alumina	0.0047	0.0002
Activated alumina containers	0.0008	0.0003
Reactivating equipment	0.0007	0.0007
Variable Charges		
Oil lost by treatment..	0.0014	0.0003
Dismantling and filling containers (labor) ..	0.0017	0.0003
Reactivation (labor) ..	0.0008	0.0001
Oil analysis	0.0001	0.0001
Total annual cost per gallon	$0.0147	$0.0065

Fixed charges are based on ten years' life of equipment. The cost of reactivating equipment may be reduced in proportion to its use for other purposes, such as batch treatment of oil used in potential or other small transformers, oil circuit breakers and lubricating and governor systems. In very light service batch treatment may be substituted for the bypass treatment if an analysis of the problem indicates a saving in expense.

Portable Apparatus Devised

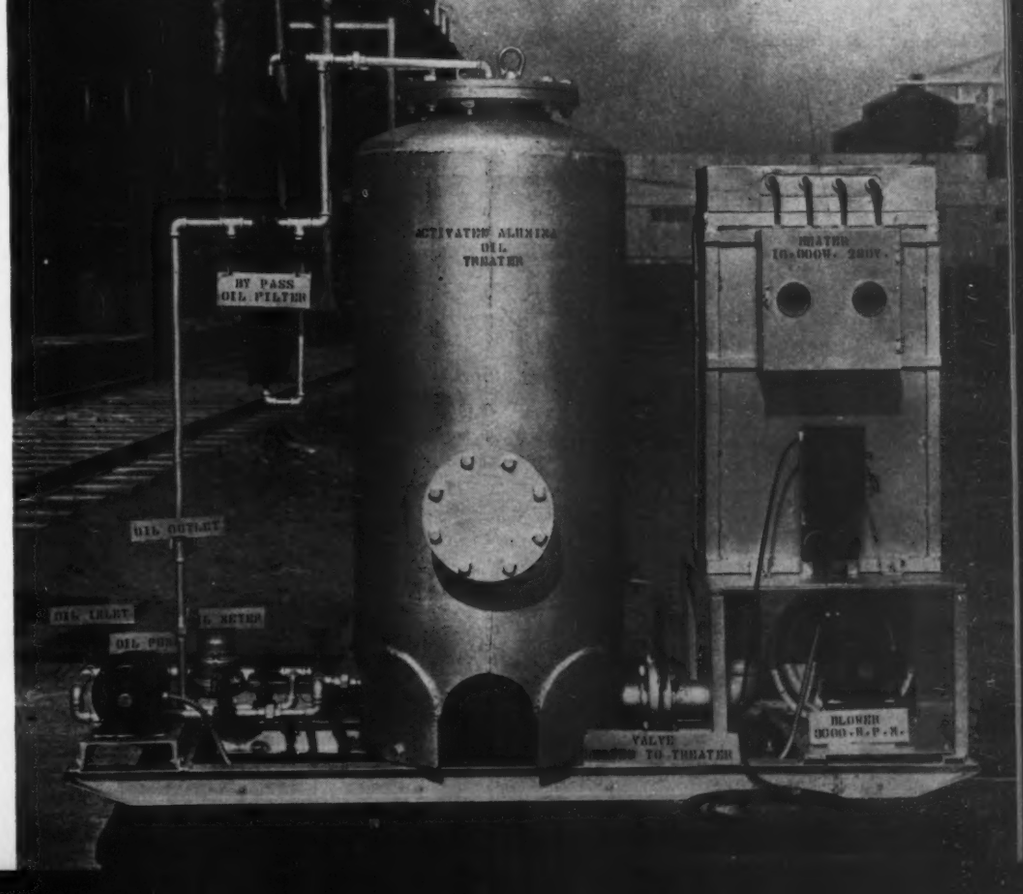
Insufficiency of other methods of oil maintenance has resulted almost entirely from their lack of universal application to the maintenance problem. The problem joins the two issues of finding a suitable material and equipment for its use which is equally applicable in the treatment of oil in a central substation or in a transformer installation hundreds of miles from headquarters. The combination reactivator and treater, of a size sufficient to reactivate 400 lb. of activated alumina, has a total weight of 1,100 lb. and may be transported on the oil servicing truck or mounted on a trailer. The same material is used over and over, thus eliminating the problem of transporting material which would have to be discarded after use. The material used in oil-

[*Continued on page 110*]



TRANSFORMER OF 14,000 kva. equipped with breather containing 20 lb. of activated alumina

COMBINATION REACTIVATOR and treater arranged for portability. This unit may be used on the trailer for reactivation of used material or for batch treatment of oil while a transformer is being given a general cleaning



Electric Service Is Supplied by People Working

Company serving rural communities features in its public relations advertising pictures of locally known employees at work

R. C. PASLAY,* Louisiana Power & Light Company

REALIZING that a company is known by the people it employs, the Louisiana Power & Light Company began in January this year an advertising campaign to place its employees and their work squarely before the public by showing actual pictures of men and women at their everyday jobs and giving a short story of how this work helps bring cheap, dependable electric service to the customers on the company's lines.

Newspapers and monthly bill inclosures are used to carry this story. The January bill inclosure carried the picture of a meter reader taking a reading. The copy referred to him as "a friendly neighbor of yours—likable, polite, always accommodating." Further copy told that this man was specially trained for his work and that he would be glad to answer questions about the company and about the customers' equipment, or teach them to read their meters.

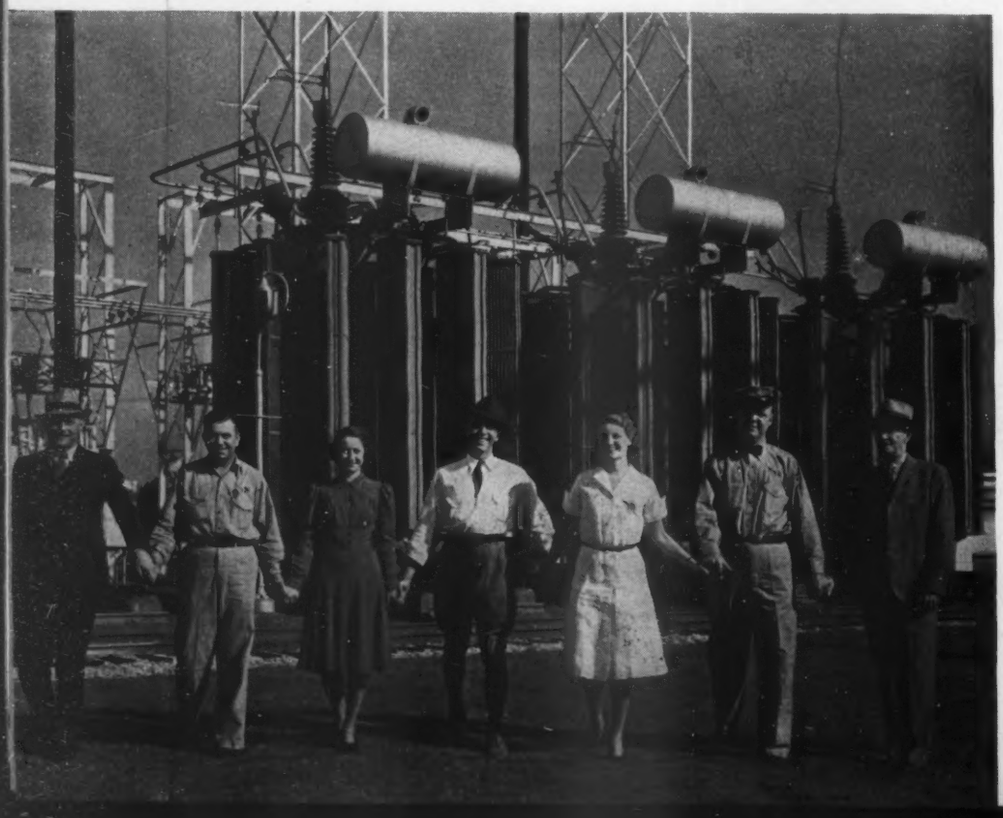
Newspaper advertising that same month showed an employee on a pole installing a transformer. The picture was made as one of the company's rural extensions was being completed. The copy started, "In just a few minutes twenty-five more families can be thankful to him." Some of the comforts these families would receive were listed. Then a few lines were given to the part the company has played in bringing cheap electricity to sparsely settled communities. A paragraph was inserted below this copy stating that the company is a good citizen and that it pays annually taxes enough to educate 20,000 Louisiana children.

The third section of the advertisement showed a group picture of seven employees, representing as many branches of the company, walking along hand in hand. Copy stressed the fact that the Louisiana Power & Light Company employs 1,000 men and women who work cheerfully, cooperatively to perform the many tasks necessary to bring cheap, dependable electric service to the communities.

Three such advertisements are scheduled for this year. In each some phase of the employees' work will be featured by actual photographs and suitable copy. Reference will also be made in each to what the taxes paid by the company will do in terms of general benefits. The aims and purposes of the organization as a whole will be set forth in copy wrapped around the group pictures.

The Louisiana Power & Light Company is a rural company serving 249 communities. In many cases the employees whose pictures are used are known throughout the particular sec-

"Marching along together"



*Sales promotion and advertising manager.

USING

Head and Hands

TO KEEP ELECTRICITY CHEAP FOR YOU

The man in the picture is operating a 110,000 volt switch at one of our sub-stations. Throughout our territory, switches like this control the power supply for a considerable area. All operation is governed by expert load-dispatchers who are on the job day and night.

These men perform a double service. They keep Cheap Electricity always on the job for you—switching instantly to another source of supply in case electric energy fails for any cause. And by seeing to it that only the needed amount of Cheap Electricity goes to specific areas, they are actually economizing for you. So sub-station operators and load-dispatchers are part of the team of 1600 Louisianians who make sure "Electricity is Cheap."

Building 50 Miles of Louisiana's Paved Highway

In one year's time Louisiana Power & Light Company contributes in taxes an amount approximately equal to the cost of building 50 miles of paved highway in Louisiana—or a distance greater than that from Baton Rouge to Hammond.

In many other ways our Company contributes to the progress of our State. We supply ample, cheap power for Louisiana's growing industries. And our industrial engineers are constantly working with national leaders to bring new business and new payrolls to our State.

MARCHING ALONG TOGETHER

"Help

One thousand f
friendly men a
together to bri
bring more po
and night, for
for you. The
day's biggest

"ELECTRICITY

LOUISIANA POWER &

"Helping Build I

MEN AT WORK and the company's taxes feature each advertisement

IN JUST A FEW MINUTES-

25 more families can be thankful to him

The lineman in this picture is installing a transformer to bring Cheap Electricity from Louisiana Power & Light Company to a new territory. Within a few minutes after the transformer is installed, 25 more families can use new electric comforts, new electric worksavers, new electric pleasures—never available to them before.

Our company is constantly building mile after mile of new line, representing tremendous initial investment—worthwhile investment because it is bringing Cheap Electricity to more and more Louisianians all the time.

In fact, our company is one of the leaders in bringing Cheap Electricity to sparsely settled territory. We are trying to make Cheap Electricity available to all.

Educating 20,000 School Children

In one year's time, Louisiana Power & Light Company contributes, in taxes, an amount approximately equal to the cost of giving a year's education to 20,000 grammar school children.

In many other ways our company contributes to the progress of our state. We supply ample, cheap power for Louisiana's growing industries. And our industrial engineers are constantly working with national leaders to bring new business and new payrolls to our state.

MARCHING ALONG TOGETHER

"Helping Build Louisiana"

One thousand people of the Louisiana Power & Light Company—friendly men and women—many of them your neighbors—all work together to bring you more joy through Cheap Electricity—and to bring more prosperity to Louisiana. Many of them are ready, day and night, for any emergency—to keep Cheap Electricity always available for you. Their skill and efficiency help keep Electricity *Cheap*—today's biggest buy!

"ELECTRICITY IS CHEAP"

LOUISIANA POWER & LIGHT COMPANY

"Helping Build Louisiana"

greater pride in their jobs and make a more earnest effort to see that the customers get prompt, efficient service. It is believed that interest in the bill inclosures and the newspaper advertisements will increase as more of them appear. As more and more pictures are collected, the company will be better able to determine the types of pictures that have public appeal and that portray interesting phases of its business.

It is believed that customers seeing these pictures of their neighbors and friends doing their regular work will read the advertisements. As a result, they will know more about how the company operates and how much is actually being done to keep the service dependable. This will unquestionably help a great deal to develop better customer relations.

tion in which they work. For that reason it is planned to use pictures of employees from different districts in order that every section of the state will have local people featured in these advertisements and bill inclosures.

Since the advertising has been under way but a little while, no definite information has been secured on the general public's reaction to the plan. Employees, however, are enthusiastic and feel that public recognition of the part they play in carrying on the work of the company puts them in better position to contact their customers. They have

Editorials

S. B. WILLIAMS, *Editor*

Why Take It Lying Down?

BUSINESS, particularly the electric utilities, is taking an awful beating from its government, and for the most part it is taking the punishment lying down. It isn't so much the legislation that is hurtful, although many of the enactments of the last eight years could be amended to make them more helpful to building business. The worst part of the dragooning has come from those who administer these laws.

The President repeatedly has asked for co-operation on the part of business. How can there be co-operation with a government that employs sadists to administer its regulatory measures? The bright young men who are working in the New Deal agencies appear to take delight in jabbing pins, in hurting. When a man like Elmer Andrews, first wage and hours act administrator, tries to be fair to business he loses his job.

Take the case of the SEC. Major policy matters may be decided by men of mature judgment, but the bulk of the operations of that agency appear to be left in the hands of young attorneys, many of whom have never had a particle of previous experience or business contact. These men have the power to demand of utilities almost anything they want, and at a moment's notice. They think nothing of calling utilities by long distance, reversed charge; of demanding attendance at Washington; of asking for any and all kinds of figures, despite the fact that they are already on file in Washington.

Why does business, why do the utilities put up with all this nonsense? It might be difficult for one utility to stick its neck out and fight the battle alone. The government would move in on that company, just as Germany has blitzkrieged Norway and Denmark. So there must be concerted action.

There probably isn't a single company that has no skeleton of some kind in its closet and the fishing that would be done to locate those long-dead bones is what is feared. But when an entire industry fights an injustice the government has no individual target at which to aim its darts.

We have a fair public in this country, a public that will act, once it has the facts. Why don't we give out the facts?

It has been suggested that utilities ought to take a greater part in politics, especially to help elect the right people to the House and Senate. The echoes of St. Louis and Georgia make that rather difficult. And besides, as pointed out above, it isn't always the regulatory measure that is bad. If we had some way of reorienting the viewpoint of our regulatory agencies much of the persecution would cease.

Such a change can come only when there is a popular demand for it. How can there be a popular demand unless the public has access to facts?

There is no place left to go but the public. Business has lost faith in the Supreme Court as being a place where unbiased judgment can be obtained. Business must go to the public if it wants justice, and it probably won't take any longer, if as long, nor cost as much as securing a New Deal Supreme Court opinion.

Voltage Drop Is Just the Same

OHM'S LAW is still on the books. The *IR* drop will still exist, no matter what insulation is used to cover the conductor. This is basic in any use made of the new wires to be permitted in the 1940 National Electrical Code.

Under the old code building wire had but one temperature rating; now there are three. These temperatures merely indicate the safe upper limits at which these insulations will operate. They do not give any greater capacity to a conductor where drop is a basic factor. In other words, drop will still be figured in the same old way irrespective of the insulation used.

The higher temperature wires can be used in places where 50-deg. insulation cannot be used. There will be boiler rooms with type C lamps, or where the cumulative thermal effect of current in the conductors in the conduit raises the temperature. But because they can be operated at higher temperatures they should not be given higher carrying capacity unless voltage drop is of no consequence, such as in a very short run.

Basing Branch Fusing on Records

APPLICATION of fuses to branch lines has increased considerably during the past ten years. The benefit of such fusing is obvious in the case of circuits not provided with automatic reclosing equipment and in those cases of extremely long rural branches where the short-circuit current is less than the relay current at the substation. When, however, branch fuses are applied either in lieu of or in combination with automatic circuit reclosing devices the benefits may well be present, but, being less obvious, analysis is needed to justify a particular combination of them.

Faults on overhead distribution circuits are divided into those that are permanent, necessitating removal and repairs before service can be restored, and temporary, being either self-clearing or failing to re-estab-

lish themselves after interruption and restoration by the circuit-reclosing device.

The relative benefits of fuses and reclosing means depend primarily upon the ratio of the temporary to permanent faults. Suppose all faults were permanent, then branch fuses would be of definite value and automatic reclosing superfluous. On the other hand, if all faults were temporary, automatic reclosing would promptly restore service, whereas branch fuses would cause a prolonged outage on that branch. Therefore branch line fusing in combination with automatic reclosing necessitates first a reliable set of records giving the division of faults into temporary and permanent, and then an intelligent selection of location for the fuses so they will disconnect a maximum of exposure area and a minimum of kva. The greater the proportion of permanent faults, the smaller the number of locations for branch fuses and the greater the amount of kva. per fuse permitted in order to show a benefit. Inversely, the smaller the percentage of permanent faults the greater the number of fuse locations and the smaller the amount of kva. per fuse permitted in order to show a benefit.

It is not sufficient, however, just to apply the fuses on this basis and merely assume that the service is improved; it is quite essential thereafter to keep careful records of performance. In order to justify fusing programs in terms of the ultimate objective—customer satisfaction—such records should be kept if possible so as to express the performance in terms of kva. and customers subjected to interruption, and be capable of interpretation in terms of how many (kva. and customers) were saved from interruption. There are undoubtedly too few such records now being instituted.

The Human Side of Safety

IS SAFETY EDUCATION a matter of operating procedure or does it belong in the larger category of employee relations? Considerable sums of money are spent on safety work. What is the justification—lower insurance costs or improved employee morale?

Here are two schools of thought, but it seems to us that they need not be incompatible. Many safety programs have largely become a matter of routine paying for themselves in the reduced insurance premiums that result from a better accident experience. The same result, however, plus perhaps other benefits, might come if the compelling motive was from the angle of employee relations rather than business economy.

Safety work on the broader program would include, in addition to accident prevention and resuscitation, the rehabilitation of injured men and a different psychological approach. Employees would be taught that the company has an interest in them as human beings. That employees have a responsibility to prevent unsafe measures by fellow employees for every major accident is a reflection on the work of all employees.

Companies that go for month after month without any major accident will find that the men are proud of the performance and they will find that the families of those men are happier.

Undoubtedly there is an element of better employee morale to be gained from viewing safety work as a matter of employee relations.

Bondholders Won't Share Responsibility

RECENTLY Chairman Frank of the Securities and Exchange Commission suggested in ELECTRICAL WORLD that bondholders should have representation in the direction of utilities. This was to get away from the complaint that a very small tail of ownership was wagging a very big dog.

The largest holders of bonds are insurance companies, banks, trust funds, endowments. Do they want representation in the management of the companies in which they are investing? Sometimes they have to take it, but when a property is in a sound condition we believe they would hesitate to place themselves in a position where they would assume responsibility for policies that later might jeopardize their holdings.

And if they did take part in management, what would be their investment position under the utility act? Since they would have equal rights with stockholders, would they become holding companies? Would they have to limit their holdings in any one company to 10 per cent?

Finally, what added protection would a bondholder have through management representation that he does not now have? What is there about a company's operations that large holders of bonds do not know? In the original indenture the bondholder has set up his protection. He is the first to be paid. Any time he does not receive his payments when due he can take over the management of the company and collect what is owing him, irrespective of what the equity holders may receive.

This is another New Deal suggestion, for which there is no authority in law, which to the general public might sound very plausible, but which is highly impractical.

Obviously, there are limits beyond which a company should not be permitted to issue bonds. Such limits are well within the powers of many state commissions. If the ownership goes through successive dilutions by means of sub-holding companies, until holdings of a very few dollars can control millions of investment, the SEC has the means of correction.

Many utilities have other than common-stock holders on their boards, but the purpose is to include the customer or outside viewpoint, not primarily to share management responsibility. This is a movement that is good and one which more utilities would find valuable.

We doubt, however, that bondholders can be induced to share management's responsibility.

Important, Whether True or Not

By CARTER FIELD

This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him

DID YOU NOTICE that little dispatch from Peoria the other day—that one about the new Diesel electric plant to be marketed at $1,700, and with a production cost of from ¾ to 1 cent per kilowatt-hour?

If you are interested in the electric industry that will bear study. Likewise, if you are a taxpayer. And the amazing part of this is that the development is of tremendous significance, whether it is true or not! Of importance to the industry because of what further progress along this line will do to small town plants, to rural electrification lines, etc. But of even greater importance because the very attention the dispatch has been given shows the widespread ignorance, even on the part of editors giving the dispatch a prominent place (and editorial attention) as to the essential details of this business of supplying people with electric current when and where they want it.

After the statement of the kilowatt-hour cost of production of this new Diesel plant, the dispatch adds: "Cheaper than hydro-electric power!"

But It Isn't

Now of course this is an inaccurate statement, even if the fake writeoffs of cost so prevalent in most government-owned projects are ignored. Plenty of privately owned, well-run hydro plants produce current at a much lower rate than that. As a matter of fact, a steam plant operating right under the noses of Senator George W. Norris and John Rankin —to wit, that of the Potomac Electric Co. in the nation's capital—puts out current at precisely three-tenths of a cent per kilowatt-hour production cost.

But this business of government competition with private ownership in the electric industry is definitely politics, and in politics it is not what is true that is important, but what the people *think* is true. Indeed, we can go one step further than that. It is not even what the people think is true, it is what the politicians *think* the people *think*.

That is the way representative government works. And that is why this little Peoria dispatch is so important, whether it is true or not. It may easily sap the very vitals of the support which so many politicians have been winning for years by the simple contention that government should supply the people with cheap, abundant electric power instead of letting them be robbed by the power barons.

It may easily—in fact, it already has—put the glimmer of a doubt in the minds of some of the people whether this spending of billions of the taxpayers' money for hydro plants to be politically operated is a sound notion.

If politics were logical, or if public sentiment were always based on the truth, the item might not be so important. Obviously, the production cost stated is considerably in excess of the cost of hydro power *if* the hydro plant is efficient, *if* it was economically built and *if* the site were well chosen. Perhaps another *if* should be added—that the plant should be honestly and intelligently operated, a pretty big *if* over any long period of years for a politically directed outfit, bearing in mind that a long period of years is required if any considerable fraction of the huge first cost of a hydro plant is to be repaid. Norris Dam alone cost $30,000,000, built in depression time, with engineering talent that would have cost much more otherwise.

But what are the public ownership advocates, the Norris-Rankin-Ickes boys, going to say in answer to the newspaper claim for this Peoria Diesel? Are they going to tell the truth and reveal to the public persuasively and generally enough to overcome this Peoria "propaganda," that the cost of production of electricity is a trifling fraction of the cost of its delivery to a small consumer?

If they do they run several risks. One is that the folks may grow skeptical of the advantage of spending billions of tax money to build hydro plants. Another is that the privately owned electric companies may do a little telling of their own. For of course if the public really got interested in this electric business the truth would finally prevail, and the public would know that power can be produced from burning coal under boilers more cheaply than by water power.

Once the public became as well informed as that, it might be possible to convince it of another factor—that privately produced and distributed power can be delivered more cheaply than publicly produced and distributed power *if* due allowance is made for the taxes paid out of each dollar collected by privately owned plants.

Penny Wise, Pound Foolish

The tragic handicap which Tacoma, Wash., hung about its neck with "cheap" municipally produced power in its race against Portland, Ore.; Spokane and Seattle, Wash., was revealed in a recent article. Tacoma was forced to high taxes *because* of its municipally owned electric plant. It was a penny wise, pound foolish course.

But even those convincing figures, as told to the House of Representatives by Congressman George Bender of Cleveland only tell *part* of the story. For it is *federal* taxes which do most of the subsidizing of publicly owned electric systems. Yet Mr. Bender's figures contained no reference to the amount of federal taxes paid, either in corporation or personal income taxes, as a result of the operation of those privately owned plants in the cities competing with Tacoma.

Don't forget that one-fifth, 20 per cent, of the net earnings of every privately owned corporation go to the federal treasury, and that a liberal chunk of the remainder is paid in personal income taxes.

NEWS OF THE WEEK

Breach Widens Between SEC and Power Systems

Government agency set on break-up of holding companies — Cities Service questions legality of integration proceedings — Electric Bond & Share ordered to present corporate simplification plan

The breach between the SEC and utility holding companies regarding procedure under the "death sentence" of the utility act widened further as court tests from several quarters assumed more definite form. The SEC is determined that its interpretation that the big systems must be broken up and the determination of the systems that their properties must remain intact has brought about a situation which the courts will be asked to rule upon.

The latest move was made by Cities Service Power & Light Co. in its answer to SEC. The utility declared that the vagueness of the powers granted the government agency by Section 11 (b) (1) of the holding company act, together with the fact that its enforcement may involve the taking of property without due process of law, renders the "death sentence" unconstitutional. It was contended that the act bestowed upon the SEC power to regulate the intrastate and local business of Cities Service subsidiaries which are "not engaged in interstate commerce."

Legality of the form used by SEC in ordering nine utility systems to submit integration plans was questioned. This order permitted the companies to retain only one integrated system and any additional ones found necessary. Cities Service contended that it was not up to the company to apply for the right to retain its properties. It was contended that it was up to SEC to show by proof that such properties cannot legally be held under the law.

Late last week the SEC brought into action Section 11 (b) (2) of the act, calling for corporate simplification of the Electric Bond & Share Co. system. Previously Electric Bond & Share was cited, along with other systems, under Section 11(b)(1) of the act.

SEC set June 10 for a hearing in Washington, at which time Electric Bond & Share will be asked to present its case. Under this proceeding, the first instituted, it is the duty of the SEC to require holding companies to take steps to simplify their corporate structures and to bring about the fair and equitable distribution of voting power among security holders. SEC said that it may be possible to consolidate the proceedings against the system.

The proceedings against United Gas Improvement Company have been postponed until May 20. The SEC is yet to rule on the question raised by U.G.I. whether the SEC followed proper procedure when it instituted integration proceedings against the company two months ago.

SEC has granted the application by the State of Maine to intervene in the proceedings instituted under the "death sentence" proceedings against Electric Bond & Share, Cities Service Power & Light, Commonwealth & Southern and North American Co. Allied Chemical & Dye Corp. was granted permission to intervene in the proceedings against United Light & Power Co., limited to its interests in American Light & Traction Co.

A.I.E.E. AT PREVIEW—More than 900 members of the American Institute of Electrical Engineers witnessed a special showing of Consolidated Edison System's "City of Light" diorama in its new dress at the New York Worlds Fair last week

DEMONSTRATION WEEK—Visitors at the electrical appliance "Demonstration Week" in territory served by Pennsylvania Power Co., which produced sales of 68 major appliances and 300 good prospects. The drive lifted April sales 61 per cent over March and 29 per cent over April, 1939. It was termed a big success

Pennsylvania Power Exhibits Appliances

"Demonstration Week," staged by Pennsylvania Power Co. in its three major stores, New Castle, Sharon and Greenville, during three successive weeks in April, pulled more than 12,000 visitors. Sixty-eight major appliance sales were closed and more than 300 good prospects secured. Dollar volume for April went up 61 per cent over March this year and 29 per cent over April, 1939.

The sales organization was of the opinion that the activity was too short and that more could have been accomplished if more time had been available. The "Demonstration Week" was built on the idea of demonstrating every major appliance carried, together with many of the table appliances. Fifteen manufacturers and distributors co-operated by supplying 24 items—cutaway models and special demonstrating displays. Newspaper advertising and spot announcements on each of the two radio stations were used, as well as direct mail. Door prizes, consisting of a $114 refrigerator, a mixer and an I.E.S. lamp, were offered in two divisions, with a $59 washer being substituted for the refrigerator in the third division.

A portable model kitchen was built and cooking demonstrations were continuous. The company stated that the drive was very successful and produced many sales and leads.

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Spur Dealer Sales of Major Appliances

The central division of Columbus and Southern Ohio Electric Co. does not go in for heavy electrical appliance merchandising, but it does a good job of creating competition for the local dealers in an effort to stimulate their range sales.

Stanley A. Dennis, sales promotion manager of the utility, declared that the division is set up as a non-merchandising property and has only a small sales force for electric ranges. Prime object is to create competition for the local dealers. The company goes competition one better by paying the dealer $15 for each range sold during the first six months this year. This is part of the promotion program.

In order to stimulate customer interest, the utility conducts an average of three cooking schools a week and offers labor-free service on all electric ranges on the company's lines within the warranty period of the range. Demonstrations of ranges are by the home economics department and they create a great deal of interest.

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Expedite Bonneville Tie-In

Two ordinances have been passed by the City Council of Tacoma, Wash., to help clear the way for Tacoma's intertie with the Bonneville power system expected around November 1. One appropriates $165,000 and authorizes the public utilities department to enlarge the tideflats substation, purchase the necessary equipment and build transmission lines to the intersection with the present Tacoma-Seattle tie-line and from there to the city limits, while the second pertains to legal obstacles. It directs the corporation counsel to purchase or to institute and prosecute action in Superior Court under right of eminent domain for condemnation of certain pieces of property for the right-of-way.

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Thorne Is Confirmed

R. W. Thorne of Williamsport has been confirmed by the Pennsylvania State Senate to a ten-year term on the Public Utility Commission. His term dates back to July 12, 1939, when he was appointed by Governor James after the 1939 Legislature adjourned.

Chattanooga System Will Not Divert Funds

The Electric Power Board of Chattanooga will not divert surplus earnings to purposes outside its own business, but will use these funds to expand its power system with a view to increasing earnings and reducing the existing rate structure, Chairman L. J. Wilhoit announced. In a letter to Mayor Ed Bass, Mr. Wilhoit said that any diversion of its surplus funds to meet city obligations would be at the expense of the consumers of electricity.

American & Foreign Power Will Spend $10,000,000

The 1940 construction program of American & Foreign Power Co. for 1940 contemplates an expenditure of approximately $10,000,000, compared with average annual expenditures for the past seven years of $6,000,000 to $7,000,000, according to C. E. Calder, president, in the annual report to stockholders.

Last year the company paid off $4,500,000 on its notes payable to banks and Electric Bond & Share. In January, 1940, an additional payment of $2,000,000 was made, reducing the original $50,000,000 indebtedness to $20,000,000 at present.

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Effective Period Extended

Federal Power Commission, upon application of Otter Tail Power Co., has extended to October 1, 1940, the effective period of its order of February 27, 1940, authorizing issuance of common stock share certificates.

BANQUET—Representative Bruce Barton of New York (second from left) was the principal speaker at the annual banquet. Others are (l. to r.) Charles E. Ide, president Southeastern Electric Exchange; Mrs. Ide, and Bryan Hanks, Florida Power & Light

Utilities Told to Defend Their Rights as Citizens

Speakers at Southeastern Electric Exchange conference caution industry to carry case to the people — Attacks against utilities diminishing — Higgins succeeds Ide as president

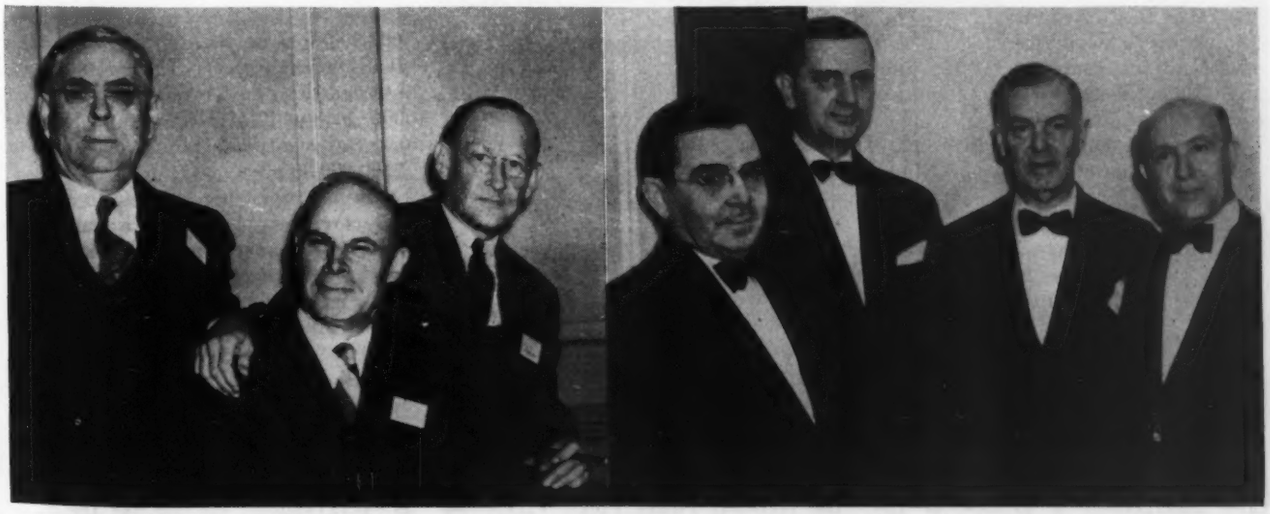
Speaker after speaker at the annual conference of the Southeastern Electric Exchange, held at Roanoke, Va., May 9–11, urged utilities to become more vocal in defense of their rights as citizens. Utilities were told that they would lose by default unless they went to the people, because the Supreme Court can no longer be expected to give business a favorable decision.

The punishment that business has taken from government was discussed from several angles during the three days. President Charles E. Ide asked what would happen if utilities functioned like government projects and eliminated the extra services now delivered in addition to kilowatt-hours.

"These services we have given," said Mr. Ide, "because we thought they were some evidence of good citizenship. They helped build good will for our companies. They stimulated sales. They were a self-imposed duty and obligation that to our minds were natural attributes to the service we supplied. And yet, as we face the future and contemplate comparison of our charges with tax-free and subsidized 'yardstick' measurements, we should perhaps give thought to the future and its implications in these respects."

Several trends in regulation were discussed by Thomas W. Ozlin, Virginia Corporation Commission. Regulatory process is speeding up. The war against utilities is diminishing and the trend is to deal fairly with companies to help them finance so they can build. Rate revisions are being approached more through negotiation. Rates are more and more reflecting the low cost of money. Trend is away from Utopian schemes and back to system of private enterprise.

Mr. Ozlin startled his audience by urging utilities to get into politics and take greater interest in electing Congressmen partial to business. He



ROANOKE MEETING—Seen at the Southeastern Electric Exchange meeting in Roanoke, Va., last week were (l. to r.) Thomas W. Ozlin, Virginia Corporation Commission; C. W. Kellogg, president Edison Electric Institute; C. A. Collier, vice-president Georgia Power Co.; J. G. Holtzclaw, president Virginia Electric & Power Co.; John Talley, executive secretary of the Exchange; M. J. O'Connell, president Virginia Public Service, and Paul Vecker, vice-president Carolina Power & Light

MACON STEAM PLANT—Workmen excavating and building forms for Georgia Power's new $4,000,000 steam station to house the 35,000-kw. Westinghouse unit. President Arkwright says this is the largest single construction activity undertaken by the company in the past ten years and is considered a most important step in expansion

charged the utilities with having taken a dragooning lying down.

Preservation of individuality is the most important problem facing the country, declared C. W. Kellogg, president Edison Electric Institute.

The public believes in private ownership, but pins its faith on government regulation, was the opinion of Elmo Roper of New York, who stated that the biggest problem of utilities is personnel; that there was no suitable replacement or second line of defense.

Close Shop Issue

H. W. Story, Allis-Chalmers Manufacturing Co., Milwaukee, discussed the issue of the closed shop, with the conclusion that the closed shop is no longer necessary to provide job security.

An illustrated description of the growth of an integrated utility system was given by Philip Sporn, American Gas & Electric Co., New York. The system taken was the central system of his company serving Indiana, Ohio, West Virginia, Virginia, Kentucky and Tennessee.

Customer research pays dividends in sales and improved public relations, according to Mrs. Genevieve McCrary, Florida Power Corp., St. Petersburg. Mrs. McCrary has been working largely with low-use customers and has been able accurately to determine markets.

Home service activities have come a long way since their beginning in the '20s, said Miss Naomi Shank, Virginia Electric & Power Co., Richmond. Miss Shank, after tracing the history and mistakes of the activity, gave management a picture of the work today.

The concluding address, "There Is Work to Be Done," by C. E. Swartzbaugh, president N.E.M.A., summarized the problems of business that have come out of the New Deal and showed how business can work out its own salvation unaided by government. He also stated that business must become vocal, that from fright it has been quiet too long.

At the annual banquet Representative Bruce Barton of New York asked for a greater concept of nationalism, of intensity of love for everything American.

Reports on Operations

Committee reports covering the year's operations were presented by R. I. Butterworth, engineering; Herman W. Boozer, accounting; R. B. Roberts, sales, and W. A. Moore, employee activities.

New developments in lighting and equipments were demonstrated by H. Freeman Barnes, General Electric, after which the Westinghouse film "The Middleton Family Goes to the Fair" was shown.

At the end of the three-day meeting A. W. Higgins, president Florida Power Corp., St. Petersburg, was elected president; L. P. Sweatt, Mississippi Power Co., Gulfport, first vice-president; C. C. Curtis, Savannah Electric & Power Co., second vice-president, and Rex I. Brown, Mississippi Power & Light Co., Jackson, third vice-president.

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Time too Short to Act on National Power Grid

Advocates of the $190,000,000 power grid proposed to the utility industry by the National Power Policy Committee now admit that there is no chance for the submission of legislation to Congress before adjournment. They say the proposal to interconnect regional power systems in strategic areas in the North and East is still under study by the industry, but they have no hope that it will be accepted before adjournment. Co-operation of the industry is essential if favorable Congressional action were obtained, either this session or next, they admit.

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Provo to Vote on Two City Plant Ordinances

Provo, Utah, voters will go to the polls in a special election May 25 to either approve or reject ordinances passed by the city commission pertaining to the city's power plant, which took over the load from the Utah Power & Light Co. on April 10.

First ordinance will provide for the issuance of $1,200,000 in electric revenue bonds; second for the recall of $850,000 electric revenue bonds used to construct the plant and to purchase the distribution system of the Utah Power & Light Co. The first ordinance will go on the ballot in two divisions, the first division to provide for refunding of $850,000 in electric bonds at a low rate of interest and the second on the issuance of $350,000 for the installation of another unit to the plant if and when needed.

Officials say the refund rate would be approximately 2½ per cent, compared to 4½ per cent now being paid. Ulen Contracting Corp. would construct the new unit.

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Roosevelt Tells Congress REA Needs $100,000,000

In a letter to Speaker William B. Bankhead last week President Roosevelt has asked Congress to provide $100,000,000 for the REA in 1941, through loans from the RFC. The President requested that the REA fund of $40,000,000 in the 1941 Agriculture Department appropriation bill be increased to $100,000,000.

An accompanying letter from Budget Director Harold D. Smith said that REA now has requests for loans totaling $70,000,000, comprising 535 applications in 44 states. This would provide 70,000 miles of new rural lines.

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Drops Acquisition Case

A stipulation has been signed by H. T. Ferguson, counsel for the Wisconsin Public Service Commission, on behalf of the commission, agreeing to dismiss the Superior, Wis., utility acquisition case.

Federal Power Venture Seen as Cost Cut Move

Chairman Olds of FPC tells savings bank group in Boston that further extensive development by government unlikely — Campbell says politicians raise rate cry to get consumers' votes

If private utilities are conducted at all times as though they faced vigorous competition, and with cost reduction as a major objective, further extensive development of governmental power facilities appears unlikely to Chairman Leland Olds of the Federal Power Commission, according to an address last week before the Boston conference of the National Association of Mutual Savings Banks.

The incentive to low costs and large sales characteristic of competitive business is the underlying purpose of government power policy, Mr. Olds declared, stating that the government's ventures into the field of public ownership are not ends in themselves, but are designed to carry out its fundamental regulatory responsibility. The development of this policy since 1933, he said, may be traced to the failure of state regulation to establish and enforce sound cost and sales standards. To the extent that the industry set its legal, accounting and engineering staffs to building up an elaborate justification of high costs, both capital and operating, the industry is today responsible for its own predicament.

Defines Objective

Chairman Olds contended that court decisions holding that the rates of any particular utility enterprise must be based upon its own costs and not upon comparative cost standards have caused the incentive to keep down costs to vanish. Doing a good job in the power business he defined as: (1) Capitalization at the minimum necessary to furnish the service, constantly adjusted to keep pace with the progress of the art; (2) minimum necessary operating costs, all padding being scrupulously eliminated; (3) rates embodying a sales policy designed to increase popular use of electricity; (4) bookkeeping which always gives a true picture of the company's business.

Closely associated with the commission's useful system of uniform accounting is the board's concern for proper treatment of depreciation. This, the speaker averred, is of the utmost importance to long-term investors, such as savings banks, which buy bonds not due until 20 or 30 years hence. Neglect of adequate depreciation accounting only can be ultimately disastrous.

Mr. Olds also declared that a duty of great importance to the commission is seeing that the accounts of all utilities subject to its jurisdiction are set up on an original cost basis, with all excess capital placed in special adjustment accounts. In the case of 116 companies aggregating property in excess of $3,000,000,000, about $300,000,000, or 10 per cent, is now by reclassification segregated in the several adjustment accounts. Companies showing adjustment accounts well below the average, i.e., with book assets closely approximating prudent investment, are those well known for below average rates.

C. L. Campbell, president of Connecticut Light & Power Co., attributed the hue and cry over electricity costs to a politician's sense of the voting power of the 24,450,000 domestic consumers of the country. He declared that cost of electricity is but a small part of the home budget. Recent claims in Congress that the people of Connecticut were overcharged $15,439,460 for electricity were declared to be absurd by Mr. Campbell.

The so-called yardstick of the government is in reality a blackjack in view of the tax discrimination practiced between public and private utilities, Mr. Campbell declared. In 1939 taxes were $8.85 per customer in Connecticut, against $1.23 in 1912, he said.

Need of securing the consent of a federal commission to capital increases after state commission approval was said to have resulted in long delay, heavy expense and, in some cases, loss of market opportunity to raise the money on the best basis. Mr. Campbell declared that abuses can be prevented without tying up the industry to a degree which almost prevents its functioning. Super-regulation, including tendencies toward managerial functioning by commissions, have curtailed and postponed many desirable betterments which would have insured cost reductions.

Mr. Campbell held that if federal regulation of holding companies and of the small proportion of interstate power business existing be necessary, operating companies should be regulated only by state commissions. Many aspects of the present utility outlook are good, he declared.

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Court Upholds Commission

Circuit Judge A. C. Hoppman has dismissed the appeal of the Northern States Power Co. from a public service commission order approving the acquisition by the village of Whitehall, Wis., of the local electric distribution system for $30,000. The dismissal order was entered on stipulation of attorneys for the utility, commission and village. The village voted April 1, 1938, to acquire the system.

DISCUSSES GOVERNMENT POWER—Leland Olds (right), chairman of Federal Power Commission, addressing the National Association of Mutual Savings Banks in Boston last week. C. L. Campbell, president of Connecticut Light & Power (left), and H. P. Gifford, chairman of the public utility committee of the association

McKee Defends Work of Private Utilities

The preservation of free enterprise in America is essential to the preservation of free government in the United States, Paul B. McKee, president of Pacific Power & Light, told an audience of students and Portland citizens last week at Reed College.

"I believe it to be the responsibility of American citizenship to oppose the efforts of any group bent on destroying a legitimate private industry through tax-free, government-subsidized competition, because if one group can succeed in doing this to one industry, then the same kind of group and the same tactics can be used to destroy all free enterprise," Mr. McKee declared.

"Fundamentally, there is no difference between the reckless use of antagonistic, government-sponsored propaganda to wreck the private utilities and the use of these same methods to destroy our democratic form of government itself," the utility president told his audience.

Mr. McKee, speaking at the invitation of Dexter M. Keezer, president of the college, followed by one week from the same platform the attack on the utility industry delivered by Dr. Paul J. Raver, Bonneville administrator. Mr. McKee defended the position of the utilities and cited their accomplishments in service, expansion of facilities and continued lowering of cost of electricity to the consumer.

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Hopson and Three Aids Indicted by Grand Jury

Howard C. Hopson, founder and former head of Associated Gas & Electric Co. utility system, was indicted last week by a federal grand jury on charges of defrauding investors of more than $20,000,000 by taking "unlawful profits" through mail fraud and conspiracy.

At the same time three of his associates were named. Those indicted with Mr. Hopson were Frederick S. Burroughs, former vice-president of the company, and Charles M. Travis and Garrett A. Brownback, senior partners of Travis, Brownback & Paxson, attorneys for the company.

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PUD Estimates Value of Utility at $2,750,000

A valuation of $2,750,000 has been set for properties of Puget Sound Power & Light Co. in Whatcom County, Wash., by the PUD in the condemnation suit now in progress in the federal court in Bellingham. It was estimated that the properties cost approximately $4,250,000 to build and they had depreciated 40 to 50 per cent.

This is the second suit of its kind in Washington and follows the recent jury decision placing a price of $6,000,000 on the properties of Washington Gas & Electric Co. in Cowlitz and Lewis counties.

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Vacates Rate Order

Federal Power Commission has vacated its orders of December 7, 1939, which suspended rate schedules purporting to provide for increased rates for electric energy sold and delivered by Arkansas-Missouri Power Corp. to Arkansas Utilities Co., and vice versa on an interchange basis. Public hearing on the proceeding, scheduled to begin April 29, is dispensed with and the schedules are deemed to have been filed and published in compliance with the Federal Power Act.

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Starts New Substation

Work has stated on the new $110,000 Sunset station of Washington Water Power Co.

MEETINGS

South Dakota Central Station Conference—Annual meeting, sponsored by the North Central Electric Association, Sioux Falls, S. D., May 19-20. W. E. Olson, secretary-manager, North Central Electric Association, 803 Plymouth Bldg., Minneapolis, Minn.

National Electrical Wholesalers Association—Annual convention, The Homestead, Hot Springs, Va., May 19-23. E. Donald Tolles, managing director, 165 Broadway, New York, N. Y.

Pacific Coast Electrical Association—Annual convention, Hotel Oakland, Oakland, Calif., May 22-24. Harold O. Noack, Hubbard & Co., Oakland, convention chairman.

Northwest Electric Light and Power Association—Accounting and business practice section, Benson Hotel, Portland, Ore., May 23-24. Berkeley Snow, executive secretary, 707 Spalding Bldg., Portland, Ore.

Edison Electric Institute—Annual convention. Atlantic City, N. J., June 3-6.

National Association of Purchasing Agents—Annual convention, Netherland Plaza Hotel, Cincinnati, Ohio, June 3-6. G. A. Renard, executive secretary-treasurer, 11 Park Place, New York, N. Y.

American Society of Mechanical Engineers—Semi-annual meeting, Milwaukee, Wis., June 17-21. C. E. Davies, national secretary, 29 West 39th St., New York, N. Y.

Public Utilities Advertising Association — Annual convention, Palmer House, Chicago, Ill., June 23-24. H. W. Olcott, Bozell & Jacobs, Indianapolis, Ind., secretary.

American Society for Testing Materials—Annual meeting Chalfonte-Haddon Hall, Atlantic City, N. J., June 24-28. R. E. Hess, assistant secretary, 260 South Broad St., Philadelphia, Pa.

American Institute of Electrical Engineers—Summer convention, Swampscott, Mass., June 24-28. H. H. Henline, national secretary, 33 West 39th St., New York.

Society for the Promotion of Engineering Education—Annual meeting, University of California, Berkeley, Calif., June 24-28.

Canadian Electrical Association—Fiftieth annual convention (Golden Jubilee), Seigniory Club, P. Q., Canada, June 25-28. B. C. Fairchild, secretary, 804 Tramways Bldg., Montreal, Canada.

Group Seeks Passage of Boulder Dam Bill

For fear complications may arise if enactment is postponed until next session of Congress, supporters of the Boulder Dam adjustment bill, introduced by Representative James G. Scrugham of Nevada, are pressing for action before adjournment.

Hearings were completed late last week before the House irrigation and reclamation committee. E. F. Scattergood, general manager of the Los Angeles municipal power system, has set up an office in a Washington hotel to push the measure through Congress. It revised the financial arrangements for sale of Boulder Dam power.

Within the near future the Scrugham bill is expected to be submitted in the Senate, introduced probably by the fourteen senators from the seven affected states.

The urge for speed is prompted by experience last year when a similar measure had to be withdrawn because interested parties failed to reach an agreement. This year there is general agreement.

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Laun to Serve Sentence

Albert C. Laun, former vice-president of Union Electric Co. of Missouri, North American Co. subsidiary, was taken to the federal penitentiary at Leavenworth, Kan., May 8 to serve a sentence of a year and a day for perjury in appearance as a witness before examiners for the SEC during its investigation of the utility.

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Transformer Standards

A committee of the American Standards Association, having completed a new set of proposed American Standards and Recommended Practices for Transformers, will issue in one volume considerable new material on standards, a test code and guides for the operation of transformers. These will be given a twelve-month trial period, during which it is hoped that the industry will make comments and criticisms.

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Virginia Public Service

Dealers in territory served by Virginia Public Service Co. sold 410 electric ranges, 1,661 domestic and 20 commercial refrigerators, 68 water heaters, 467 washers and five ironers during April. Sales reached a volume of $351,013. During May and June advertising will promote "Electric Cold."

Output Curve Takes Sidewise Movement

Output of the electric light and power industry during the week of May 11 was 2,387,566,000 kw.-hr., an increase of slightly less than 0.1 per cent, and 10 per cent above the corresponding week of 1939, according to the Edison Electric Institute.

While the rise above the preceding week was seasonal, the amount compared with gains of 0.3, 1.5 and 0.9 per cent for the corresponding periods of 1939, 1938 and 1937, respectively. For the week of May 11 production of electricity was 21.4 per cent above the corresponding week of 1938 and 8.8 per cent ahead of 1937, the narrowest margin above the latter year for any week in 1940. With reference to the winter peak, output for the week of May 4 was 9.6 per cent under last winter's high; corresponding decreases for 1939, 1938 and 1937 were 8.1, 10.6 and 3.6 per cent, respectively.

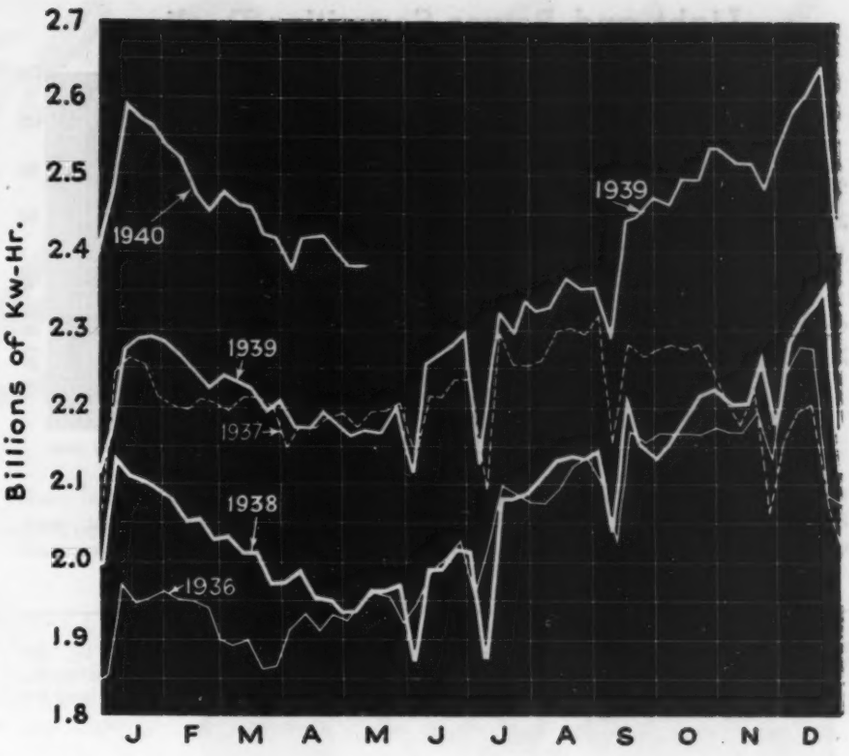
All of the major geographic regions showed increases for the week of May 4 over last year, though in most cases the gains were smaller than in the previous week.

Weekly Output Millions Kw.-Hr.

1940		1939		1937	
May 11	2,388	May 13	2,171	May 15	2,195
May 4	2,386	May 6	2,164	May 8	2,176
Apr. 27	2,398	Apr. 29	2,183	May 1	2,194
Apr. 20	2,422	Apr. 22	2,199	Apr. 24	2,188
Apr. 13	2,418	Apr. 15	2,171	Apr. 17	2,173
Apr. 6	2,381	Apr. 8	2,174	Apr. 10	2,176

Per Cent Change from Previous Year

	Week Ending		
	May 11	May 4	Apr. 27
New England	+ 5.3	+ 8.1	+ 5.0
Middle Atlantic	+ 4.5	+ 4.7	+ 6.0
Central Industrial	+15.8	+17.1	+14.4
West Central	+ 6.9	+ 6.0	+ 8.2
Southern States	+14.3	+14.4	+12.3
Rocky Mountain	+12.4	+15.2	+13.6
Pacific	+ 0.6	— 1.4	+ 1.3
United States	+10.0	+10.3	+ 9.8



Illinois Electric Sales Up in March

Total sales of electricity to ultimate consumers by the eleven largest Illinois electric utilities during March, as compared with the totals for the corresponding month last year, revealed a 7.1 per cent increase in revenue, a 9.1 per cent increase in kilowatt-hours and 1.7 per cent increase in the number of customers, according to a report by the rates and research section of the Illinois Commerce Commission.

Residential sales in March revealed increases of 5.1 per cent in revenue, 9.3 per cent in kilowatt-hours and 1.7 per cent in the number of customers as compared with the same month last year. The total residential kilowatt-hour sales this month were 3.4 per cent lower than for February, 1940.

Rural sales continued to register increases in March, 1940, as compared with the same month last year, when revenues gained 16.9 per cent, kilowatt-hours 26.0 per cent and the average number of customers 14.8 per cent. Power and other sales in March increased 7.9 per cent in revenue and 8.9 per cent in kilowatt-hours when compared to March, 1939. It should be noted, however, that for the same period the 1.6 per cent decrease in total number of customers was affected by one company changing its method of counting small power and light customers.

•

Utilities and Co-ops Add Farm Families to Lines

Approximately 12,500 farm families have obtained electric service since the first of the year, it was estimated recently by J. Walter Marquardt, executive secretary of the Illinois Rural Electrification Committee. This figure, Mr. Marquardt said, represents farms added by both the utility companies and the REA co-operatives and brings the total number of Illinois farms with electric service up to 92,500.

William W. Hart, acting chairman of the Illinois Commerce Commission and a member of the State Rural Electrification Committee, also announced that during the year 1939 the commission certificated for construction by the utility companies a total of 2,064 miles of rural line to service 5,077 rural customers and 1,803 prospective farm customers.

New York Utility Plans New $150,000 Building

District Manager William H. McElwain of New York State Electric & Gas Corp. has announced that the company will soon award contracts for construction of a three-story and basement office and utility building.

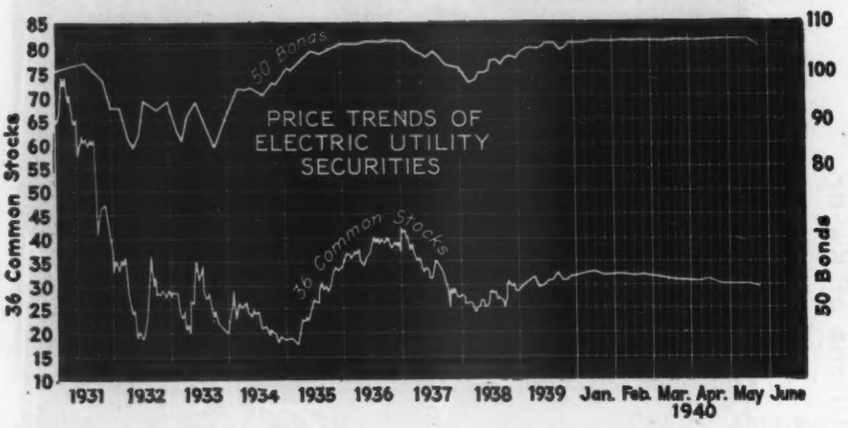
The building will be located at State and Market Streets, Elmira, N. Y., and is expected, with equipment, to cost more than $150,000.

•

Decatur Calls for Bids

Board of Works of the Decatur, Ind., City Council will receive bids for remodeling the municipal power plant and furnishing equipment in connection with the half-million dollar improvement program on June 6. Estimates for the construction work and equipment involved total $124,000, including $67,000 for construction items. Equipment to be bid on will include a coal-handling device for the new boiler; two 1,500-kva. transformers, three phase; switchgear; three single-phase transformers, 250 kva capacity, and other items.

Light and Power Securities Decline



Under the pressure of war developments, prices of securities crumbled this week. Electric light and power securities participated in the break. "Electrical World" stock and bond index reached new lows for the year—stock 29.1, last week 31.3, last year 29.4; bond 105.4, last week 106.3

Utilities Register Proposed Offerings

Carolina Power & Light Co., Raleigh, N. C., has filed with the SEC an application regarding the proposed issue and private sale to life insurance companies of $46,000,000 of 3¾ per cent first mortgage bonds. Proceeds from the sale of the bonds will be used to redeem $38,500,000 of 5 per cent first and refunding mortgage gold bonds, due in 1956, and to pay at maturity $7,500,000 of the company's underlying and assumed Yadkin River Power Co. 5 per cent first mortgage gold bonds, due on April 1, 1941.

Among other statements recently filed with the commission are the following:

Indianapolis Power & Light Co., $32,000,000 first mortgage 3¼ per cent bonds, series due 1970 and 140,591 shares of 5¼ per cent cumulative preferred stock, $100 par value. Proceeds will be used for refunding purposes.

Iowa Southern Utilities Co., $10,000,000 of 4 per cent first mortgage bonds, due May 1, 1970, and $2,660,000 of 4½ per cent general mortgage sinking fund bonds, due May 1, 1950. Proceeds will be used for refunding.

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Will Continue Dividend

At the recent annual meeting of stockholders John E. Zimmermann president of the United Gas Improvement Co., stated that the company expected to continue to pay the $1 annual dividend. The quarterly dividend of 25 cents, payable June 29, has been declared.

•

Votes Capital Reduction

Stockholders of the Cities Service Co. have approved retirement of 41,589 shares of common stock held in the treasury, reducing the company's capital by $415,894. They also approved a plan for reimbursing non-salaried directors and for indemnifying directors and officials in special instances.

FPC Acts on Amendment

Federal Power Commission, acting upon the second amendment (filed April 6, 1940) of the Nevada-California Electric Corp .to its application filed July 31, 1939, has authorized the issuance of $100 par value 3 per cent cumulative plus 4 per cent non-cumulative preferred dividend shares in exchange for 7 per cent cumulative preferred dividend shares and the issuance of $10 par value shares of common stock to be exchanged share for share for outstanding $100 par value shares.

•

Clears Up Arrears

New Orleans Public Service, Inc., a unit in the Electric Bond & Share System, has voted to clear up all arrearages on the company's $7 preferred stock. The payment being made on May 31 to shareholders of record of May 24 will be $17.50 a share, or an aggregate of $1,361,465. Earlier this year the company paid $14 a share on account of arrears on its preferred stock.

Utility Reports

	Net Income 1940	1939
*American Wts. Wks. & Elec. and subs.	$3,944,212	$2,327,111
*Arkansas Power & Light	1,161,558	1,349,555
*Central Illinois Public Service	2,115,765	1,758,929
*Consolidated Edison Co. of N. Y.	36,745,006	34,647,814
*Consolidated Gas Elec. Lt. & Pwr. Co. (Balti.) and subs.	6,913,278	5,980,757
*Florida Power & Light	1,923,777	1,733,177
*Houston Lighting & Power	2,725,269	3,028,324
*Kansas City Pwr. & Lt.	3,972,358	3,649,699
*Louisiana Power & Light	1,105,400	999,408
*Louisville Gas & Electric (Ky.) and subs.	2,929,735	2,576,507
*Montana Power and subs.	3,540,862	2,778,620
*New Orleans Public Service	2,508,452	1,652,784
*Texas Electric Service	1,496,148	1,079,225
*West Penn Power and subs	6,275,274	5,746,734

*Twelve months ended March 31.

New Issues of Electric Light and Power Securities in April

Name of Company	Amount (Par Value)	Offered to	Period	Class	Purpose	Interest Rate	Price	Per Cent Yield
Kansas Gas & Electric Co.	$16,000,000	Sold privately	30	First mortgage bonds	Refunding	3⅜	105	3.12
Toledo Edison Co.	3,000,000	Public	30	First mortgage bonds	Refunding	3¼	104½	3.02
	7,250,000	Public	20	Sinking fund debentures	Refunding and additions and betterments	3½	102	3.36
West Penn Power Co.	3,500,000	Public	30	First mortgage bonds, series K	Improvements, additions and betterments	3	104½	2.78
	4,320,000	Public	....	Common stock	.....	....	27	....
Indianapolis Power & Light Co.	1,652,520	Public	....	Common stock	Reimburse treasury for capital expenditures	....	24	....
	250,000	Sold privately	....	Cumulative preferred stock	.....	6	100	6
Kansas Power & Light Co.	13,916,900	Public and stockholders	....	Preferred stock	Refunding	4½	103	4.36
Wisconsin Electric Power Co.	3,600,000	Public	....	Preferred stock	Refunding	4¾	100	4.75
Total	$53,489,420							

Versatol Insulated Cable

REG. U.S. PAT. OFF.

With three properties that can be translated into terms of long-time low-cost service

MOISTURE resistance (0.01), heat resistance (75 C), and long life (504)—these are the three most desired properties that are all combined in Versatol rubber insulation. They are the reasons why you can expect economical, long-time service from any type of cable insulated with this compound.

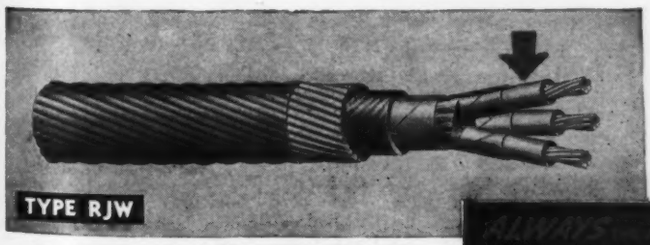
These properties can be translated into cost-saving advantages:

0.01 *Water-absorption factor in gram per sq in.* This permits running the cable under water without any additional moistureproof covering. Lead sheath is unnecessary.

75 C *Maximum operating temperature.* This may allow a reduction in conductor size—with savings in space and cost.

504 *Hours in oxygen bomb at 300 lb per sq in.* This is a standard accelerated-aging test, which is said to approximate 50 years of natural aging. Such long life means savings in maintenance and improvements in service.

Balance these advantages against the slightly higher first cost of Versatol, and you can figure that this high quality can be measured in terms of long-time economies. A G-E cable specialist will be glad to analyze your requirements to see just what these economies would be. General Electric Co., Schenectady, N. Y.



R, rubber-insulated; **J,** jute; **W,** wire armor

ALWAYS THE RIGHT TYPE FOR EACH JOB

WIRE-ARMORED

This is one of the many types of Versatol rubber-insulated cable. It is the wire-armored type, which is popular as nonleaded submarine cable and also as dredge-feeder or vertical-riser cable. The armor is put on over a jute cushion and is further protected with over-all compound. Wire armor, usually of steel, has high mechanical strength; it can also stand abrasion and yet is quite flexible.

There are many types of insulated cable available; remember that you profit most when the type you select for each job is *always* the right one. To this end, make full use of G-E service and get the most for your cable dollar. Look for the *right* type for long-term economy.

GENERAL ELECTRIC

500-6

OPERATING PRACTICES

Adjustable D.C. for Meter Testing

A continuously adjustable d.c. voltage supply for testing direct-current meters at the electrical laboratories of the Consumers Power Company, Jackson, Mich., is supplied by the electronic circuit shown in the accompanying diagram.

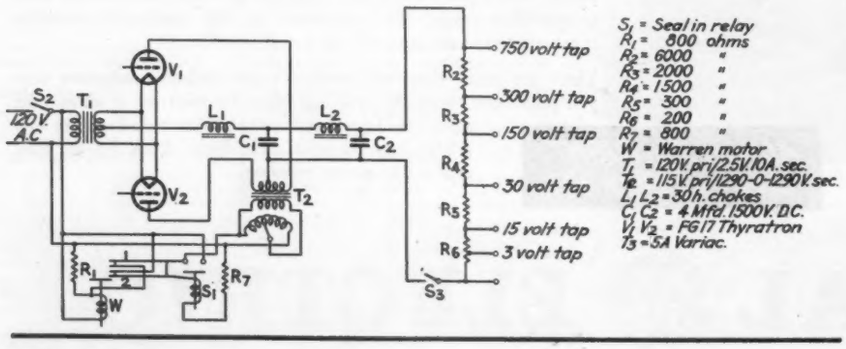
Two F G 17 thyratron tubes give full wave rectification of the 120-volt a.c. supply. A variac in the primary circuit of the plate voltage supply transformer provides a means of varying the d.c. output voltage from 0-750 by changing excitation applied to the rectifier tubes.

A relay arrangement in the primary circuit of the plate voltage supply transformer provides a time delay of about 40 seconds to allow the rectifier tubes time to reach a stable condition before load is applied. Operation of the time-delay relay arrangement is as follows:

When the main supply switch S_2 is closed the filament supply transformer is energized and the Warren motor driving the cam starts. As the motor starts contact No. 1 is closed, having been left in this position from previous operation. Contact No. 2 is open. Shortly after the motor starts contact No. 1 opens, which does not affect the circuit in any way. In 40 seconds the cam closes contact No. 2 momentarily, which in turn closes seal-in relay S_1 supplying voltage to the plate transformer, which can now be adjusted to any desired value by means of the variac. The Warren motor continues to run until the cam again closes contact No. 1, which shorts out the motor winding and stops the motor. When switch S_2 is opened seal-in relay S_1 drops open and the device is ready for the next operation.

It may be well to add that the plate transformer used is capable of producing more than 1,500 volts. As an added safety feature the variac is provided with a stop so that the voltage cannot be raised over 900.

ELECTRONIC d.c. voltage supply device for meter testing



SCHEMATIC DIAGRAM of d.c. supply circuit

Condenser Tube Repair Avoids Replacement

A simple, efficient and low-cost method used to recondition eleven-year-old condenser tubes at the Dresser station of the Public Service Company of Indiana saved about $78,000 when severe tube erosion threatened to make complete replacement necessary two years ago. All new tubes for the three 40,000-sq.ft. surface condensers would have cost about $84,000.

The condenser tubes, of 18 gage admiralty, were 30 ft. long and 1 in. outside diameter. They were severely eroded for the first 1½ in. of their length only on the intake end of each of the two passes, and although the exact cause of the erosion was never definitely established the failure of the intake end only, plus the presence of a thin film of copper on the packing nut at the discharge end, led to the belief that electrolytic action was primarily responsible. This electrolytic action, if such it was, probably was helped along by the use of non-metallic packing between the tubes and the tube sheet.

Whatever the cause, the method of repair employed was simplicity itself. The first 1½ in. was cut from each end of the tubes (the discharge end being cut off to remove old packing necking), leaving them all 3 in. short. Then the sleeve and nipple

WHEN LIGHTNING STRIKES

It's Arrester PERFORMANCE That Counts

THAT'S why your distribution transformers will give you better service continuity, with maximum operating life, when protected by G-E pellet arresters.

Performance Doubly Proved

The protective performance of pellet arresters of every rating has been proved by that most exacting scientific method—the cathode-ray oscillogram. Oscillograms show the arrester impulse-voltage characteristics for various discharge currents, including currents even in excess of the highest recorded in field measurements of discharges on distribution systems.

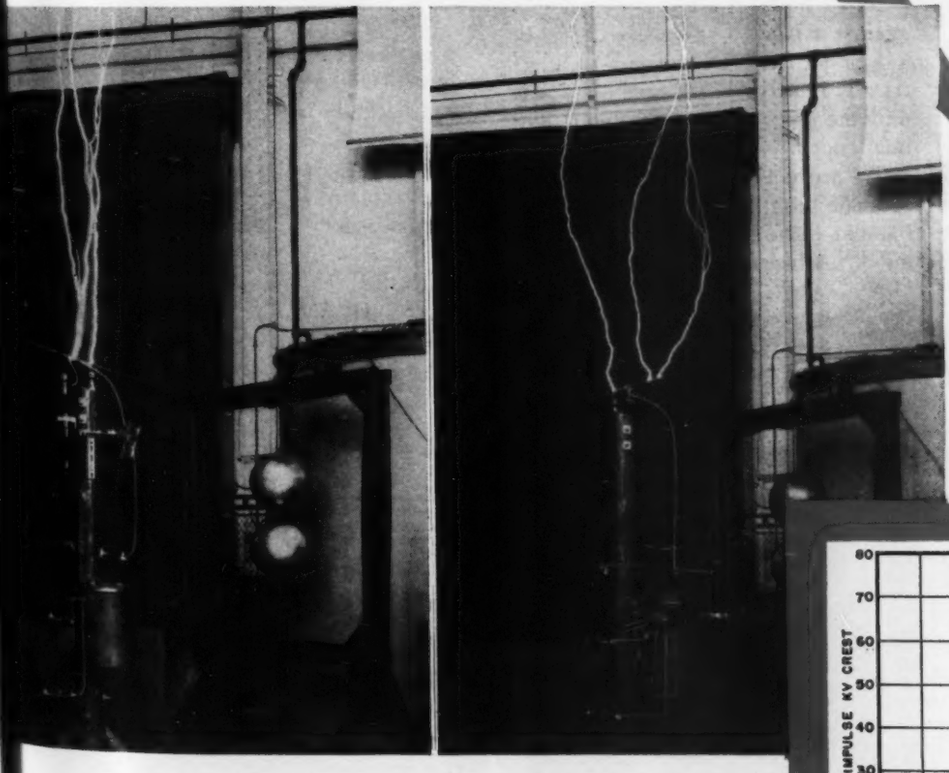
Pellet arresters have further proved themselves by successfully undergoing high lightning voltage and high discharge-current tests on typical distribution set-ups—with the arresters mounted separately or directly on the transformer tank. Even in these severe tests, pellet arresters have proved that they "can take it."

And in the field, the modern pellet arrester, with its recent refinements in electrical and mechanical design, is setting a new standard in performance and operating reliability.

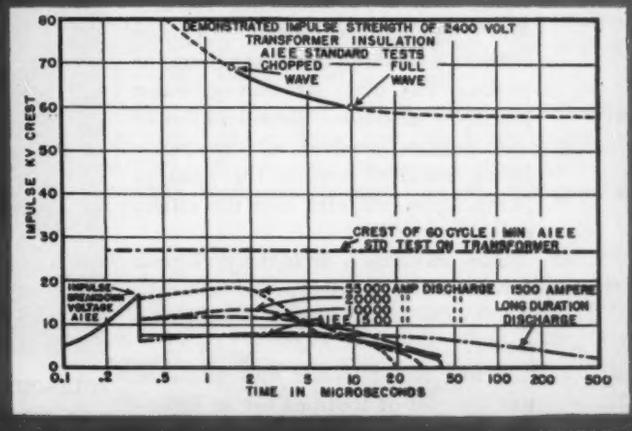
Look at the Picture of REAL PROTECTION

In the graph below, note that the exceptionally low impulse breakdown voltage of the 3-kv pellet arrester starts discharge at a voltage far below the A.I.E.E. impulse test strength of a new 2400-volt transformer. The pellet arrester's unusually low IR characteristic similarly limits the lightning voltage—giving an immense margin of protection. In fact, even with 55,000-ampere discharges, the protection level is well below the 60-cycle, 1-minute crest test voltage of a new 2400-volt distribution transformer. This means that your transformers have plenty of margin of protection, even assuming considerable depreciation of transformer insulation with the years.

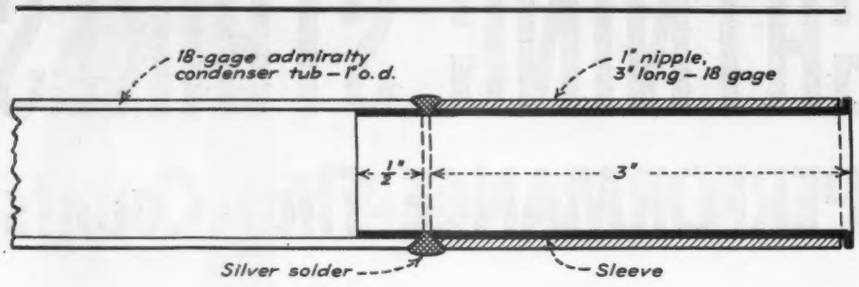
Select your G-E pellet arresters from Bulletin GEA-2975. General Electric, Schenectady, N. Y.



In the Pittsfield Works high-voltage laboratory, pellet arresters successfully undergo tests with high impulse voltage and high impulse currents. Typical pole set-ups are used, with arresters mounted separately (left) and with arresters mounted directly on the transformer tank.


DEMONSTRATED IMPULSE STRENGTH OF 2400 VOLT TRANSFORMER INSULATION
AIEE STANDARD TESTS
CHOPPED WAVE
FULL WAVE
CREST OF 60 CYCLE 1 MIN AIEE STD TEST ON TRANSFORMER
IMPULSE BREAKDOWN VOLTAGE AIEE
55,000 AMP DISCHARGE 1500 AMPERE
LONG DURATION DISCHARGE
IMPULSE KV CREST
TIME IN MICROSECONDS

GENERAL ELECTRIC



SLEEVE AND NIPPLE SCHEME replaces eroded portion of condenser tube—Sleeve is removed after nipple is soldered in place

arrangement shown was silver soldered to one end, bringing the tubes to length. The nipple portion of the fixture was of the same diameter, thickness and composition as the tube proper. Both tube and nipple were champfered at 45 deg. to accommodate the bead of solder. The sleeve is extremely thin, since its only function is to stiffen the nipple and hold it in place during the soldering operation. It also prevents solder from forming on the inside of the tube. After buffing and removal of the sleeve the tube was tested with 100-lb. air pressure while submerged in water.

As a final precaution against electrolytic action the non-metallic tube packing was supplemented by metallic packing to establish a positive metallic connection between the tube and tube sheet. The repaired tubes have been in successful service two years to date.

•

Circulating Water Pump Placed Outdoors

With space already at a premium in the pump house at the Dubuque, Iowa, plant of the Interstate Power Company increased condenser circulating water requirements recently forced company engineers to choose between extending the pump house or putting the new circulating water pump out of doors. Consideration of cost factors resulted in the pump being installed outside the existing pump house, directly over the intake well.

The pump is a 15,000-g.p.m. unit driven by a weatherproof 200-hp., 2,300-volt, 875-r.p.m. induction motor.

Prime factor in the final decision was the cost of footings for an extension of the pump house. The Dubuque plant is located on the west bank of the Mississippi River and the pump house is but a very short distance from the river. Periodic floods (which occasionally have come within a few feet of flooding the pump house) made exceptionally heavy footings necessary for the existing building. Cost of extending these footings far outbalanced any disadvantage of locating the pump outside.

In fact, location of the pump motor over the intake well has a distinct advantage in this case since it permits use of a submerged type pump. The pumps housed indoors operated against a 15-ft. suction head. Use of a weatherproof motor and an electrically interlocked oiling system permits the unit to operate outdoors and unattended.

To prevent oil in the drip lubricator on the pump motor from draining out during idle periods, leaving the thrust bearing dry on starting up, a solenoid valve has been provided in the oil line leading from the lubricator. When the pump oil circuit breaker in the plant is opened to shut the pump down an auxiliary switch energizes the solenoid from the plant d.c. supply, closing the pipe line. When the pump is started the solenoid is de-energized and the valve opened.

SOLENOID VALVE controlled by pump o.c.b. prevents loss of oil from drip lubricator during idle periods

Push-button stations mounted on the pump motor and in the station permit it to be started or stopped in the station or at the pump location by the operator on his regular hourly inspection rounds.

Experience with the outdoor unit has been so satisfactory during its single year of operation that company engineers are considering external location for all future circulating water pumps on the system.

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Wire Puller Pays Cost on First Job

By GEORGE HAUSMAN
Distribution Engineering Department
Cincinnati Gas & Electric Company

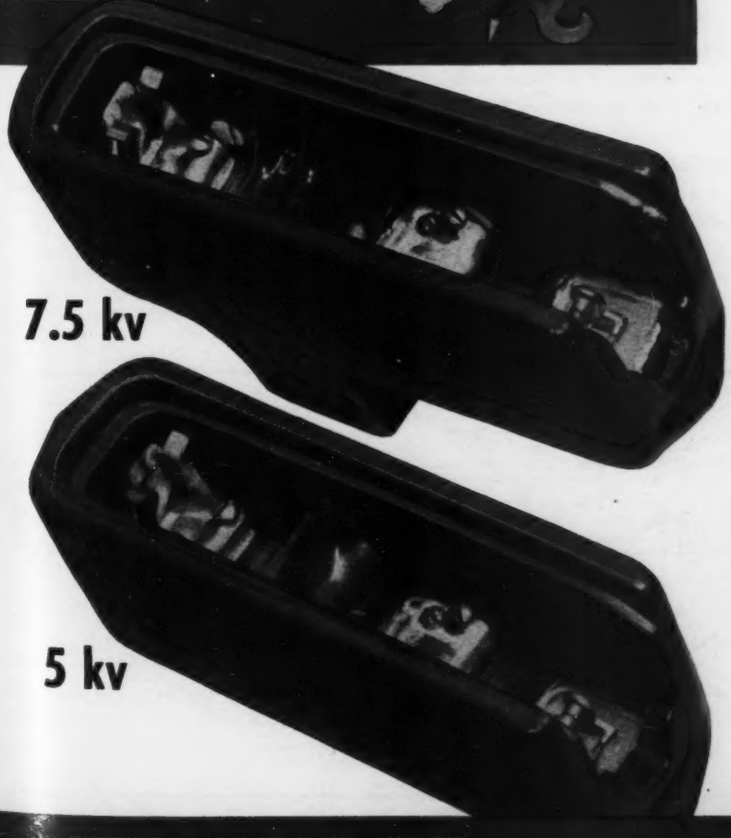
Lessons learned from a previous, but not entirely satisfactory, winch-driven machine for pulling and reeling line conductors, destined for reuse, have been incorporated in a new self-contained trailer unit that cost $525, exclusive of trailer and winch. The new machine, which is capable of pulling and reeling a mile of wire in less than an hour, was built to expedite the job of relocating an existing 66-kv. transmission line in which the pulling and reeling of 33 miles of 300,000-circ.mil stranded copper wire for reuse was involved. The machine paid for its cost in savings on this, its first job.

Objective of the new design was to build a machine that would be portable, and that could be set up to make long pulls in one piece, to eliminate splices in the conductor. Wire is pulled out through stringing blocks in lengths to fill a reel. The tail end of the wire is snubbed with a rope to keep it tight.

The mechanism, which is trailer mounted, consists of two side-braced "A"-frame supports for the reel shaft bearings, which can be removed to change the reels. Standard wood reels are used and are driven by large steel spiders attached to the reels with bolts or lag screws and keyed to

WANT TO REDUCE STOCKS—SAVE TIME AND TROUBLE?

DISCONNECT door with indicating and isolating feature
TWO-ELEMENT reclosing door with one-second time delay
SINGLE-ELEMENT door with selecting device for indication or dropout



Let the Doors Do It

2 housings and 3 doors meet 80% of your cutout requirements

HOW many *different* cutouts do you carry in stock? How many different fuseholders? Really, it's a revelation to learn what you can do to simplify the job of your storekeeper and lineman—and get greater flexibility of cutout application—if you will use G-E enclosed indicating and dropout fuse cutouts.

For example, you can take care of 80 per cent of your distribution fuse cutout requirements with just *five* major parts.

And the best of it is that you can adopt this simple program very easily. You don't have to stock all five of these parts immediately. Here's the way you do it:

First: You buy our 50-amp indicating and dropout fuse cutout in the 5- and 7.5-kv ratings. (Perhaps you're doing that now.) That gives you two housings to take care of all voltages not exceeding 8 kv (13.2 kv Gr Y) across any one cutout. The doors are identical and interchangeable.

Suppose you are ready to use reclosing cutouts at sectionalizing points or on branch circuits or at transformers serving important customers or located in out-of-the-way places. You have already installed G-E indicating and dropout cutouts. All you do is take a G-E two-element *reclosing door,* send out a trouble crew to change doors. No line crew required —no installation costs—and they are the lowest-cost expulsion type.

What about disconnects? Simply take our new design disconnect door. This, too, fits both housings. Furthermore, it has an indicating and isolating feature that saves time and makes for greater safety.

Two housings and three types of doors. General Electric is the only manufacturer who offers this stock-reducing, money-saving combination. Why not look into it today? General Electric Company, Schenectady, N. Y.

GENERAL ELECTRIC

Cincinnati Gas & Electric Co.

SELF-POWERED mechanized unit pulls and reels one mile of conductor per hour—cost $525

the reel shaft. The reel shaft is driven at a variable speed of about 15 to 30 r.p.m. by a chain drive through reduction gearing from a discarded hoisting winch. Power for the winch is supplied by a Ford model A, four-cylinder engine complete with clutch and battery for ignition and starting. A silent-type spur gear which is mounted on the transmission shaft of the engine meshes directly with the winch gear.

To obtain speed control of the reel motor normally operates at low speed with the transmission in high gear. Second and low gear provide additional low-speed ranges. The clutch gives very good control over the operation of the reel, which must be started and stopped as often as is necessary to keep the wire wound evenly on the reel.

Engine power is in excess of the calculated 15 hp. required to pull one mile of wire, but is considered better than a stationary engine because it is equipped with a starter, generator, transmission, clutch, etc. Maximum torque developed at the reel shaft is limited by the drive chain, which is good for 3,000 ft.-lb. safe load.

This machine has proved very successful. Its cost was not excessive, as shown by the following itemized list covering cost to construct the machine, exclusive of the trailer and winch, on hand.

Ford engine complete with tank, radiator, battery, etc	$200
Structural steel	25
Gears, chain sprockets, bearings, etc.	100
Labor and engineering	200
Total	$525

•

Terminating Cable Without Potheads

By R. B. McKINLEY
Wire and Cable Division,
General Electric Company

It is often desirable to terminate rubber - insulated, metallic - shielded, braid-covered cable without using potheads. Usually the particular conditions to be met, as well as individual preferences, will determine whether stress cones, over-all friction tape and over-all paint are to be used or omitted.

Stress cones can be omitted to simplify terminating and lessen its cost on circuits where surges will not be troublesome, or where experience has proved them unnecessary. But to avoid corona, the end of the shielding and an inch or two of the insulation should be covered with splicing tape, friction tape and paint.

In general, oil base or ozone-resisting rubber insulations withstand sunlight much better than mineral-base compounds. With these more-resistant insulations it is permissible to expose the bare insulation beyond the shielding tape or to cover it with a paint finish only. This construction lasts longer than friction tape and paint, but is not as easy to renew. At stations where inspection and renewal are not difficult and where outages may be more serious the friction tape and paint combination is more economical. The paint and tape finish is also advantageous for indoor terminations.

The following method may be used for terminating rubber-insulated, metallic-shielded, braid-covered cable employing a stress cone, over-all friction tape and paint overall:

1. Cut the cable to its proper length, leaving the conductor long enough to extend into the terminal lug.

2. Remove the outer covering over the metal tape for a distance of A + C + 1 inch + length in the terminal lug.

3. Remove the tape and insulation exposing the conductor for the length to go into terminal lug plus 1 inch.

4. Attach the terminal lug to the conductor with solder.

5. Taper the insulation for the distance D.

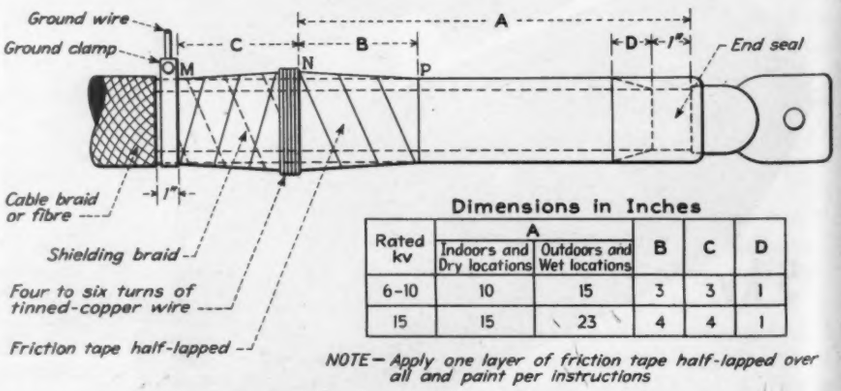
6. Attach copper shielding braid by passing a turn of tightly drawn braid around shielding tape at end of the cable covering. Solder the braid to the tape. Unwrap the shielding tape from the cable and cut it off at the edge of the applied braid. Tie the remaining length of braid on its roll. (Be careful not to injure the insulation underneath.)

7. Remove the rubber-filled tape next to the conductor insulation for the distance A + C.

8. Apply the end seal. Thoroughly clean the surface over which the splicing tape is to be applied. Coat with rubber cement. After the solvent has dried fill out for a distance D + 1 inches with splicing tape.

9. Build up the stress cone for the length B + C. Apply splicing tape on insulation between points M and P so that the thickness at N is equal to 75 per cent of the thickness of factory-applied insulation. The additional thickness should decrease uniformly to zero at M and P.

10. Apply the previously anchored shielding braid up to the maximum diameter on the stress cone in tightly drawn ⅛-inch lap wrappings. Spot solder to hold in place. Terminate the braid by cutting ½ inch beyond the soldered point. All loose ends should be turned down and soldered to the preceding turns. Over the shielding braid tightly wrap 4 to 6 turns of No. 19 tinned copper wire and solder. Solder together all turns of braid and wire along three lengthwise lines equally spaced around the braided surface.



Dimensions in Inches

Rated kv	A: Indoors and Dry locations	A: Outdoors and Wet locations	B	C	D
6-10	10	15	3	3	1
15	15	23	4	4	1

NOTE—Apply one layer of friction tape half-lapped over all and paint per instructions

DRAWING SHOWS bare cable and insulation dimensions

Reasons why

3 Extra-heavy Porcelain Coordinated Bushings with Liberal Creepage... Offer Maximum Reliability Under Fog, Dust, Chemical, or Other Adverse Operating Conditions.

4 Double Conductor Insulation Provides Double Safety Against Winding Failures.

5 New Spra-bonderizing... Plus Triple Coat Automobile Finish... Gives Positive 4-Way Protection Against Rust and Corrosion.

6 Time-proven Core and Coil Construction... Designed for Years of Efficient, Service-free Operation.

TRANSFORMERS *Cut Operating Costs*

INDUSTRIAL ENGINEERING

Switching Sled for Construction Power

By K. N. BANTHIN
Oak Park, Ill.

Mobility, high salvage value, safety and circuit protection commensurate with that secured on indoor circuits can all be claimed for the switching sled shown in the accompanying illustration. This sled was developed to protect a temporary system supplying power for a construction job.

Feed to the switching sled is 440 volts, three phase, over a four-wire tellurium-rubber-covered cable, the fourth wire of which is used as a continuous ground. The cable terminates at the sled in a service head which is connected to the ground wire.

Mounted on the sled is a 100-amp. oil switch with overload protection and three 30-amp. disconnects with thermal overload protection. The switch is mounted exposed, as shown. The three smaller units are in the wooden box, together with three four-wire plug receptacles at the bottom. Safety stops for locking out any circuit from the sled are provided on each switch.

MOBILE switching equipment on sledge protects construction power circuits

When the picture was taken the oil switch was feeding a bank of two compressors, and as only a three-wire cable was available for service the extra single wire cable, seen coming off the service head, was used as the continuous ground.

As construction activities shift beyond the limits of the feeder cable the sled is dragged to its new location by one of the tractors on the job.

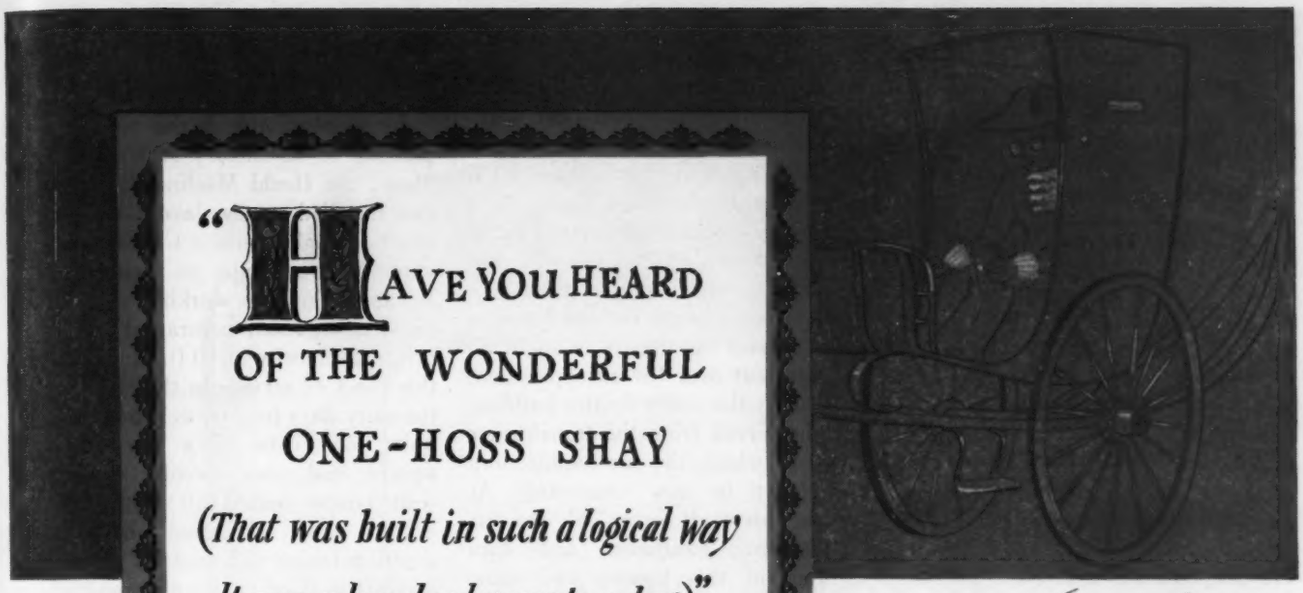
•

New Compressors Save Power and Space

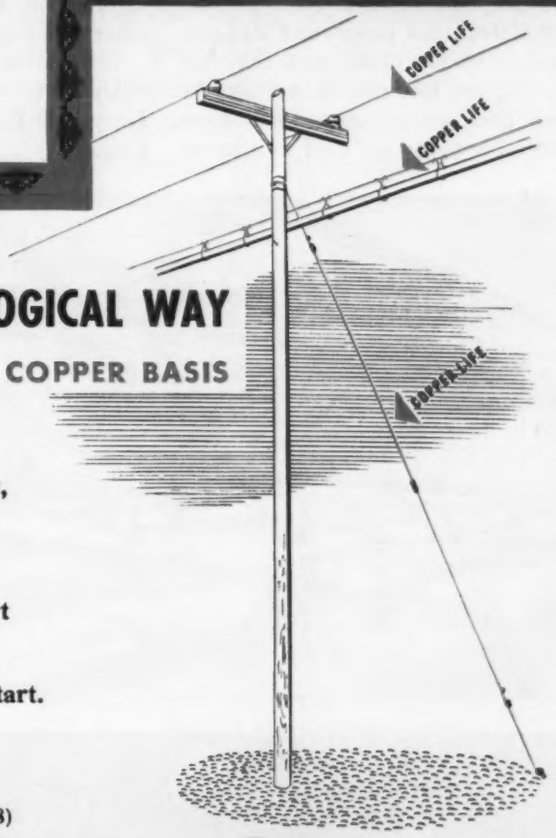
Savings of 36 per cent in horsepower and 80 per cent in floor space were effected in a recent modernization of the air-conditioning installation at the State-Lake Theatre, Chicago, where two fifteen-year-old d.c. motor-driven reciprocating compressors were replaced by high-efficiency, hermetically sealed condensing units of a modern type.

When the State-Lake Theatre was acquired two years ago by a Chicago theatre chain it was served with direct current from the Commonwealth Edison system in the loop district of this city. Availability of a.c. from the utility's new network in the

SEALED COMPRESSORS yield double economy in Chicago theatre. These two d.c. driven CO_2 refrigerating machines (left) required 90 more horsepower and 800 sq.ft. more space than the four modern units (right) that displaced them



"HAVE YOU HEARD
OF THE WONDERFUL
ONE-HOSS SHAY
(That was built in such a logical way
It ran a hundred years to a day)"



BUILD OVERHEAD LINES THIS LOGICAL WAY

PUT GUY and MESSENGER LIFE ON A COPPER BASIS

There are traces of age in the one-hoss shay,
A general flavor of mild decay,
But nothing local, as one may say.
There couldn't be,—for the Deacon's art
Had made it so like in every part
That there wasn't a chance for one to start.

. . .

Logic is logic. That's all I say.

Oliver Wendell Holmes (1858)

COPPERWELD STEEL CO. · GLASSPORT, PA.

PUTS STRAND LIFE ON A COPPER BASIS

PERMANENTLY MOLTEN-WELDED COPPER EXTERIOR SURROUNDING AND PROTECTING STEEL CORE

COPPERWELD

NON-RUSTING

GUY and MESSENGER STRAND

area, coupled with need for general theatre modernization, led to replacement of the inefficient CO_2 air-conditioning equipment with one less costly to operate and more in line with equipment in other theatres of the Balaban & Katz chain.

Accordingly, four 40-ton, Westinghouse condensing units, totaling 100 hp., occupying 200 sq.ft. and weighing 10 tons, displaced the two old 100-ton, 125-hp. d.c. refrigerating machines that occupied 1,000 sq.ft. and weighed 83 tons without foundations.

Whereas the old equipment was supplied at 230 volts d.c. the new compressors are operated at 208 volts, three-phase, four-wire from the 115/208-volt network. Four parallel 500,000-circ.mil paper- and lead-covered cables per phase, with four No. 1/0 cables for neutral, supply the load from an adjacent vault. Four cables per phase are used to increase the reliability of the power supply. If failure occurs on any of the four parallel cables it may be cut free and the remaining three will carry the load. From the vault the cables run to a 3,000-amp. main three-phase I-T-E air circuit breaker and thence to a bus system behind the new switchboard, from which circuits are tapped through fused three-pole knife switches to the various loads.

At present the theatre is about 35 per cent cut over for a.c. operation. Eventually the entire theatre building will be served from the transformer vault to which the air-conditioning equipment is now connected. At present this vault serves only the air-conditioning equipment and sign lighting of this theatre and some other buildings in the neighborhood.

Installation of the air-conditioning equipment was engineered by the Kroeschell Engineering Company of Chicago.

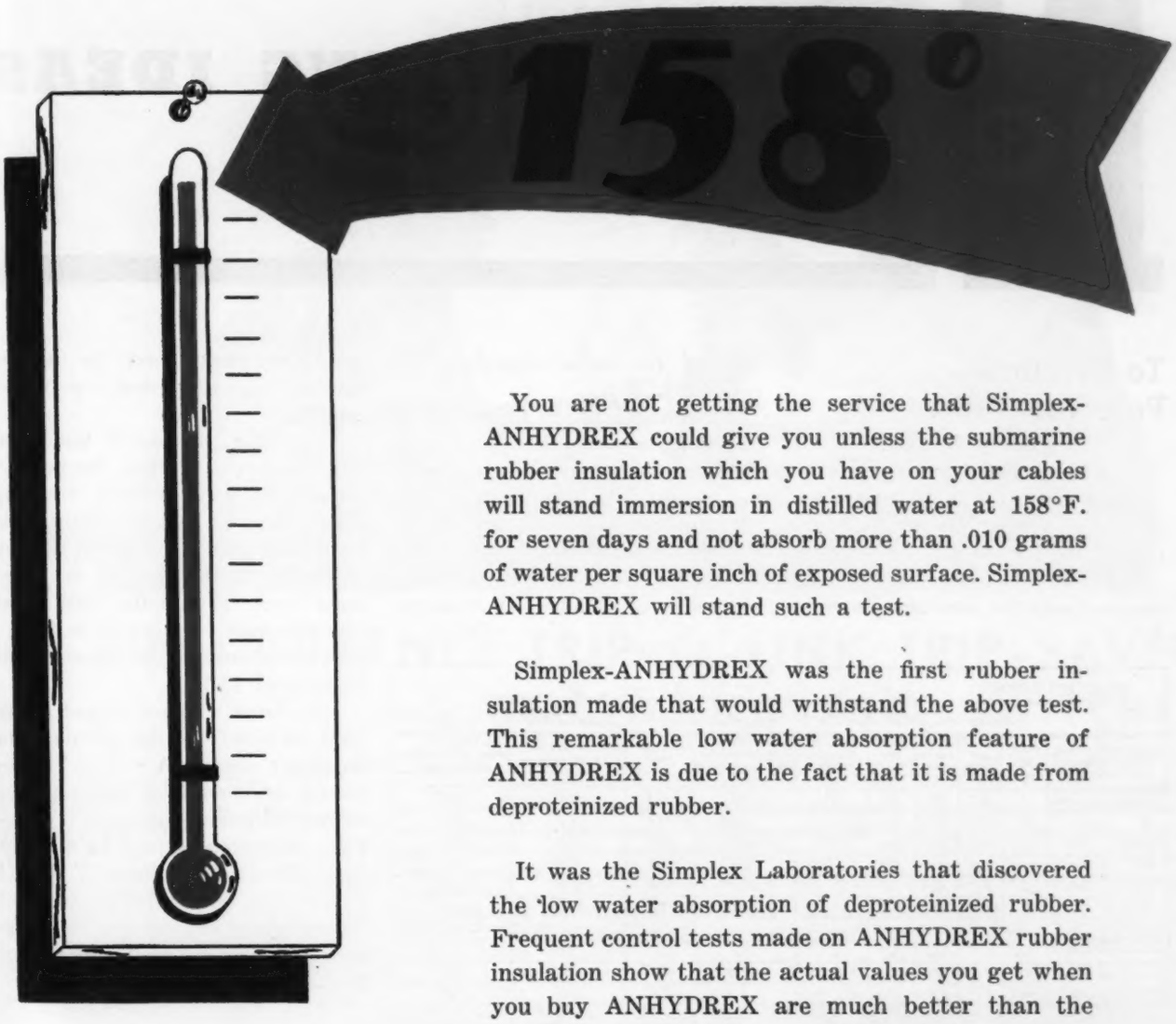
DAYLIGHT ILLUMINATION of relighted drafting room shown for comparison with electric service (top); night view with high-intensity units (bottom) →

65 Ft.-Candles for Drafting Room

In connection with the recent expansion of its factory at Worcester, Mass., the Heald Machine Company has installed a new layout of combination high-intensity G.E. mercury vapor-Mazda lamps to deliver 65 ft.-candles on the working plane in the drafting room, contrasted with an original intensity of 10 ft.-candles for this class of service in the shop. In the early days four 60-watt bowl type units took care of a bay 20 ft. square, and more recently six 200-watt lamps spaced 10 x 6 ft. on centers were suspended above six drafting tables and about 8 ft. 6 in. above the floor to supply about 20 ft.-candles in a 20 x 20-ft. bay. The latest installation consists of 3,400 watts per bay, the units each consisting of three 150-watt Mazda lamps and a 400-watt mercury, with mounting heights of from 14 ft. 7 in. to 14 ft. 10 in., spaced 10 ft. apart in each direction, with four units per bay.

Distribution Scheme

The main lighting distribution switchboard of the shops is laid out for three-phase, four-wire, 120- 208-volt service. The installation was made by Coghlin's, Inc., Worcester, according to the general designs of Albert Kahn, Inc., Detroit, and is associated with a relocation of main transformer units and switching facilities at a level above the production floor, and a wiring layout of increased capacity and flexibility. Each pair of high-intensity lighting units is supplied with energy from a G. E. "Tulamp" transformer mounted on the structural steel framing of the shop, and the power factor at the lighting units is about 95 per cent, with practical nullification of the stroboscopic effect. The starting current of a pair of lighting units is but 4.5 amp., increasing to 7.5 amp. at full efficiency. In case a severe voltage dip should occur, one of the two mercury lamps will remain in service unless the drop exceeds the vicinity of 35 per cent. The Mazda lamps, of course, continue to operate short of extremely low voltage or full interruption. The wiring is laid out to control the four mercury units per bay from one Westinghouse Deion circuit breaker, with a second to control the four Mazda lamps.



You are not getting the service that Simplex-ANHYDREX could give you unless the submarine rubber insulation which you have on your cables will stand immersion in distilled water at 158°F. for seven days and not absorb more than .010 grams of water per square inch of exposed surface. Simplex-ANHYDREX will stand such a test.

Simplex-ANHYDREX was the first rubber insulation made that would withstand the above test. This remarkable low water absorption feature of ANHYDREX is due to the fact that it is made from deproteinized rubber.

It was the Simplex Laboratories that discovered the low water absorption of deproteinized rubber. Frequent control tests made on ANHYDREX rubber insulation show that the actual values you get when you buy ANHYDREX are much better than the guarantee — sometimes going down as low as .005 grams. If your cable troubles are complicated by a water absorption problem then ANHYDREX is the rubber insulation you are looking for.

A card will bring you the latest ANHYDREX information available.

Simplex Wire & Cable Co., 79 Sidney Street, Cambridge, Mass.

Simplex-ANHYDREX

deproteinized rubber insulation for wires and cables

NEW ENGINEERING IDEAS

To Evaluate Pole Test Data

By VERNON W. PALEN
Northern States Power Company, Eau Claire, Wis.

As a means to determine more accurately when poles are to be replaced, the author has developed a calculator which evaluates test data obtained with the increment borer in terms of "per cent of original strength remaining."

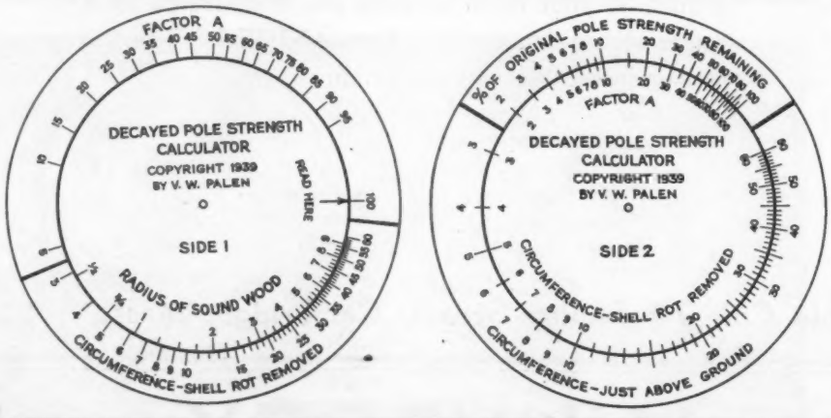
Three field readings are necessary: (1) Original circumference of pole, measured about 6 in. above ground to the nearest inch with a steel tape; (2) circumference with shell rot removed, measured about 6 in. below ground to nearest inch with steel tape; (3) radius of sound wood, measured with increment borer to nearest quarter-inch after shell rot is removed.

Using the convenient test form illustrated for recording, the two circumference measurements are first made. Then, by referring to the table on the left side of the form it is easy to see how deep to go with the increment borer. Thus if the shell rotted circumference (column F) is 30 in., the table shows that the borer should be inserted 4¾ in.

Data from columns E and F are used on side 1 of the calculator to determine factor A, which is recorded in column G. (Where a large number of poles is involved, it is better to determine factor A for all poles first). Data from columns F, G and H may then be applied to side 2 of the calculator and the per cent original strength remaining read off and recorded in column I.

POLE TEST REPORT BY INCREMENT BORER — 2.3 K.V. LINE FROM Town A TO Town B — DATE ..... 19.....
Any Light & Power COMPANY — Eastern DIVISION

TABLE CONVERTING CIRCUMFERENCE TO RADIUS		POLE NO.	KIND OF WOOD	BUTT TREATMENT	HEIGHT OF POLE	RADIUS SOUND WOOD	CIRCUMFERENCE 6" BELOW GROUND SHELL ROT REMOVED	FACTOR A	CIRCUMFERENCE 6" ABOVE GROUND	% ORIGINAL POLE STRENGTH REMAINING
		A	B	C	D	E	F	G	H	I
CIRCLE	RADIUS	1	NC	No	30	1	25	68	28	48
19	3	2	WRC	YES	30		new pole		27	100
20½	3¼	3	NC	NO	30	2½	30	95	33	69
22	3½	4	NC	NO	30	1¼	25	78	28	56
23½	3¾	5	NC	NO	30	2	25	94	27	73
25	4	6	WRC	YES	30		new pole		28	100
READ RADIUS.		34	NC	NO	30	0	21	0	31	0
COLUMN G FOR OFFICE USE ONLY		35	NC	NO	30	2¼	24	95	29	52
NOTE WHICH POLES HAVE BADTOPS ON REVERSE SIDE OF SHEET		36	NC	NO	25	1½	17	95	26	26
		AVERAGE VALUES FOR ALL POLES TESTED							27.30	43.25%



CALCULATOR helps to determine more accurately when poles are to be replaced

Pole test data, recorded on test form (above) are applied to the two sides of the calculator (below), which evaluates them in terms of "per cent of original strength remaining." Space limitations have necessitated the shortening of the test form. The table at the left-hand side of the form may be completed by adding one-fourth inch to the radius for each 1½ in. increase in circumference.

Record Rotor Action on Motor "Pull-In"

By E. W. SWANSON
Research Engineer, Electric Machinery Manufacturing Company, Minneapolis, Minn.

To study the actions of synchronous motor rotors in pulling into step when field current is applied to the rotor winding at different speeds and rotor displacement angles a "strobograph" was developed by the Electric Machinery Manufacturing Company, Minneapolis, for recording each pull-in performance.

The device produces a record consisting of dots punched in blueprint paper by a high-voltage timing spark from a 110/9,000-volt, 60-cycle trans-

It's these KEARNEY TRIP-O-LINK TRIP-SAVER RE-CLOSING FUSE SWITCHES

CHECK LIST of Important Things to Consider . . . .

- ☐ Switch Doesn't Use Cartridges
- ☐ Blown Fuse Held Safely in Contact
- ☐ Time Delay if Desired
- ☐ Inexpensive Initial Cost
- ☐ Guaranteed Performance

If you use Kearney Trip-O-Link Trip-Savers, you'll check 100% with the important features listed above.

We have less interruptions; less costs in patrols; definitely better customer service — because Kearney Trip-O-Link Trip-Savers afford two-shot protection. These modern, inexpensive reclosing switches clear faults dependably—then restore a second fuse—maintaining continuity of service and customer good will along with assurance of greater revenue.

Investigate the money-saving advantages of these time and field-tested Kearney Trip-O-Link Trip-Savers, rated 5,000 to 15,000 V., 50 Amps. Ask a Kearney Representative—or write.

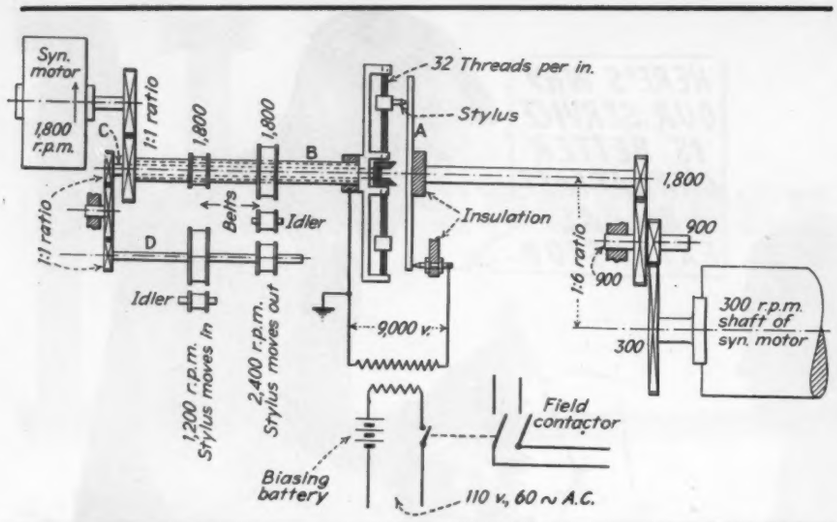
Wedge-type Copper-weld Contacts provide a pressure of 30 to 40 pounds on the fuse wire, to give a noiseless contact.

A spiral contact spring applies proper and uniform tension on the fuse link and permits speedy release when a fault occurs.

The time delay is a practical, simple device which stores up energy—energy which is properly expended when fuse blows.

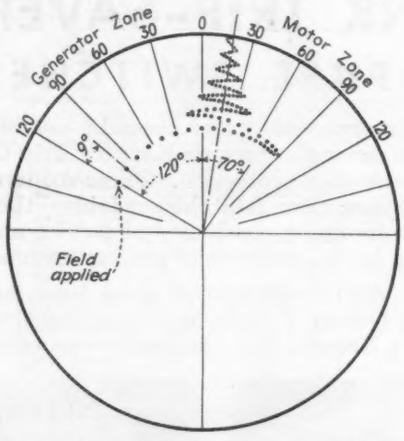
Use **KEARNEY PRODUCTS**

JAMES R. KEARNEY CORPORATION
4224-42 CLAYTON AVE., ST. LOUIS, MO.
Canadian Plant, Toronto - Canada



DEVICE GIVES GRAPHIC RECORD of rotor displacement as synchronous motor pulls into synchronism

Stylus assembly is mounted on radial screw with bearings at both ends and bevel gear at inner end. Bevel gear is driven by bevel pinion on shaft *C*, which passes concentrically through shaft *B* driving stylus arm. Shaft *C* is driven by countershaft *D*, which, in turn, is driven at one of two speeds from main shaft *B* through either step-up or step-down pulley ratio. Idler arrangement on loose belts tightens them and drives shaft as desired. If counter shaft runs 1,200 r.p.m., stylus moves in toward bevel gear, but at 2,400 r.p.m. stylus moves outward from shaft center. To keep proper balance, weight equal to stylus assembly moves radially and simultaneously in opposition to it.



GRAPHIC CHART for 50-hp. synchronous motor shows rotor action during pull-in

This 50-hp., 300-r.p.m. synchronous motor was accelerating 60 per cent full load and had a large flywheel. The 9-deg. angle between first and second dot indicates that the field was closed at 95 per cent speed and 120 deg. in the generator zone. In pulling into step the motor reached synchronism at 90 deg. in the motor zone and finally settled at 18 deg. from zero displacement.

former, primary of which is energized when the field contactor closes. One side of the transformer is connected through the frame of the device to a stylus, rotating at synchronous speed. From this stylus the spark jumps through the chart paper to a metal disk that is driven by the test motor and connected to the other side of the transformer through a brush.

On the strobograph record the angle between a radial line through the first spark dot and the zero displacement line on the chart is the angular displacement at which the field contacts closed, while the angle between successive dots indicates the speed of the test motor at any instant. The chart also shows the angular swings of the test rotor in coming to synchronism.

In the diagram shown the synchronous motor under test drives disk A and the chart through gearing at 1,800 r.p.m. when the motor is in synchronism. Since an 1,800-r.p.m., 60-cycle motor has four poles, the chart will have four poles equaling 720 electrical degrees. The stylus, from which the timing spark jumps to the chart, is driven at exactly 1,800 r.p.m. by a small synchronous motor. Thus, any markings on the chart made by the 60-cycle spark record the rotor movements of the large test motor.

In order that dots on the record do not superimpose on each other the stylus is arranged so that it may be driven radially toward or away from the center of the chart at ½ in. per second.

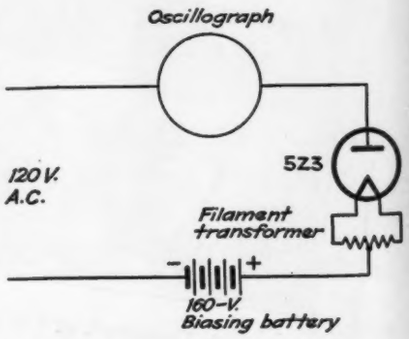
The chart record is clearer if the step-up transformer used to supply the timing spark has a decidedly peaked voltage wave, thus giving punctures only when the instantaneous value of the peak is above a certain value. A battery in the transformer primary will emphasize half waves in one direction more than in the other, thus making corresponding dots larger.

•

Radio Tube Solves Oscillograph Problem

A simple electronic "trick" employed by engineers of the Consumers Power Company, Jackson, Mich., has proved effective in making a standard laboratory cathode-ray oscillograph give the very large deflection necessary for accurate measurements of instantaneous variations in lighting voltage arising from arc furnace and welding loads. Interest lay only in the variations in the magnitude of the peaks of each voltage wave, and since size of the instrument was not sufficient to give the deflection necessary an electronic method was devised to cut off all but the peaks of the positive half waves.

As shown in the accompanying schematic diagram a 5 Z 3 rectifier tube, with its plates connected, was inserted in series with the oscillograph across 120 volts a.c. and provided with a 160-volt d.c. biasing battery in the filament circuit, with its polarity opposing the polarity of the rectifier tube. Effect of the rectifier tube was to give half-wave rectification, while the biasing battery suppressed all but approximately 10 volts of the half-wave peak. Small variations in lighting voltage due to operation of the arc furnace or welding load were clearly measurable in this portion of the wave.

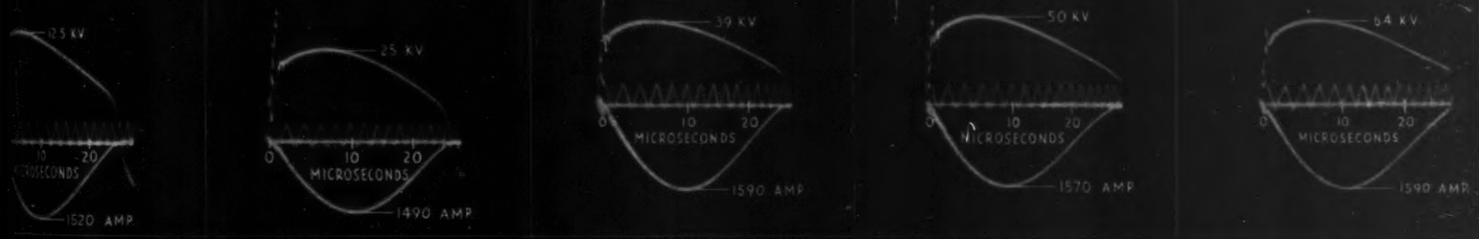


SIMPLE TUBE CIRCUIT suppresses all but peak of half-wave for oscillograph study

TEST PROOF

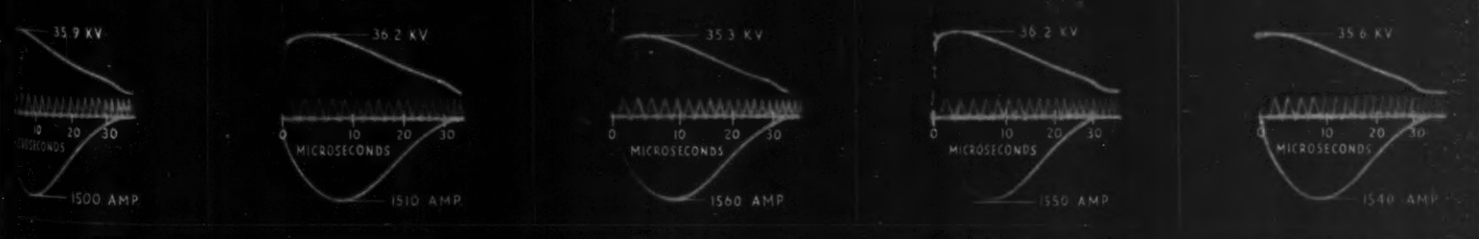
OF L-M "HEAVY DUTY" LIGHTNING ARRESTERS

TESTS ON A. I. E. E. STANDARD SURGES SHOW



ILLOGRAM OF 3000 VOLT ARRESTER | OSCILLOGRAM OF 6000 VOLT ARRESTER | OSCILLOGRAM OF 9000 VOLT ARRESTER | OSCILLOGRAM OF 12000 VOLT ARRESTER | OSCILLOGRAM OF 15000 VOLT ARRESTER

TESTS ON 9000 VOLT ARRESTER FOR PERMANENCE SHOW



LTTIME CURVE ON 1st SURGE | VOLT-TIME CURVE ON 31st SURGE | VOLT-TIME CURVE ON 85th SURGE | VOLT-TIME CURVE ON 236th SURGE | VOLT-TIME CURVE ON 320th SURGE

HIGH SURGE CAPACITY is characteristic of L-M "Heavy Duty" Lightning Arresters. These arresters will withstand surges of 60,000 amperes.

LOW FOLLOW CURRENT assures freedom from blowing of sectionalizing fuses — and assures long life of Lightning Arrester.

THE ISOLATOR—Outages due to follow-current through damaged Arresters are eliminated. The ISOLATOR at the bottom of each L-M Arrester is absolutely accurate and dependable — it operates fast and ONLY after damage of the valve material.

A visual indicator in blown position. The Isolator is an exclusive feature of L-M Arresters — Ask your L-M representative about its 100% record or write to

LINE MATERIAL CO.

MILWAUKEE, WISCONSIN

for greater protection against Lightning Use L-M "Heavy-Duty"

LIGHTNING ARRESTERS

LOAD BUILDING

Ovens and Roasters Mean "Plus" Business

By A. E. SMITH
Advertising Manager
Central Maine Power Company, Augusta

Central Maine Power Company, a utility serving approximately 75,000 domestic meters in the central portion of Maine, is selling roasters and ovens to about one per cent of its meters, judging from the present trend of this popular "upper bracket" appliance. Officials of the company look upon these appliances as "plus" business. Usually the user is on the upper bracket of the rate and the revenue earned from a roaster or a portable oven in many instances compares favorably with a range which necessitates heavy installation charges.

The company started early last spring with a test campaign on a portable oven in one of the larger cities. Results proved satisfactory and warranted an extensive campaign throughout the system during May and June which accounted for sales of approximately 400 portable ovens.

Following this campaign the company introduced a roaster promotion during the months of July and August, in which another couple of hundred roasters were sold. Sales continued to come in, many of them from friends of enthusiastic owners, and the total number of units sold for the year exceeded 750.

Plenty of newspaper space, inclosures with service bills, window displays with emphasis on a free home trial are the only means that the company uses in selling these roasters. Practically no outside selling is done, all activity resulting from within the store, phone or mail. Low down payments are always used in order to make it just as easy as possible for the customer to buy.

January is becoming known as "Casserole Month" in Central Maine Power Company territory for the company during the past three years has promoted casseroles consistently and advantageously. Last January about 600 casseroles were sold. In previous one-month campaigns from four to five hundred units have been sold. Every sale of a casserole helps to make another and satisfied users are the ever-waiting prospects for roasters, for portable ovens and for ranges.

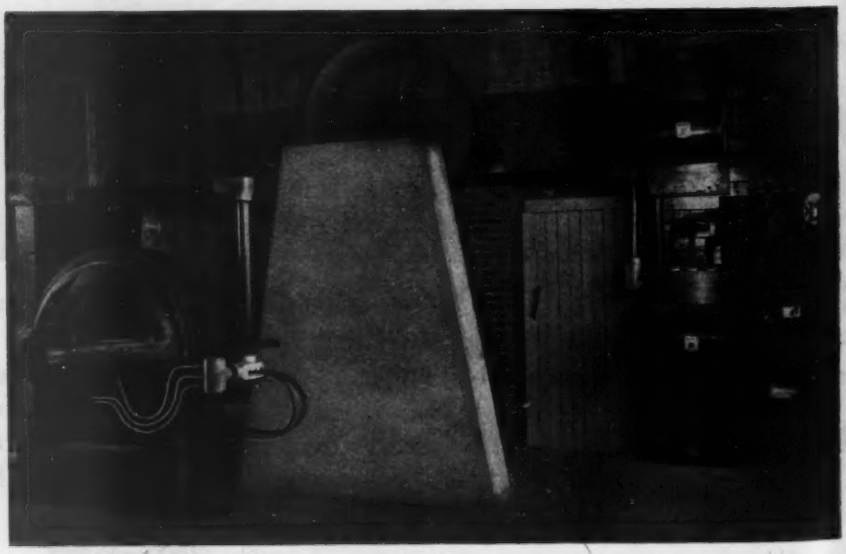
Store men in the company's territory are on a bonus basis. A quota is set for each store and a bonus is paid for all business done over that amount. This in a large measure is responsible for the keen cooperation of all floormen, for promotions of all small appliances are eagerly looked for and backed up 100 per cent.

Flour Mill Employs 251 Hp. for Processes

By B. H. MILLER
Power Sales Engineer, Consolidated Gas, Electric Light & Power Company, Baltimore, Md.

Moderate-sized flour mills represent a power load of interesting proportions when it is considered that a 400-bbl.-per-day mill can profitably employ 5 kw. in lighting and 251 hp. In our territory a flour mill was able to obtain a large part of its grain from local sources and undertook a thorough renovation of the mill, installation of some new machinery and the use of modern purchased power for all operations.

Electrical equipment now installed consists of a 150-hp. motor to drive line shaft which operates main mill machinery, a 25-hp. hammer mill, two grain elevators (35 hp.) a flour mixer of 15 hp., as well as auxiliary apparatus such as conveyors and

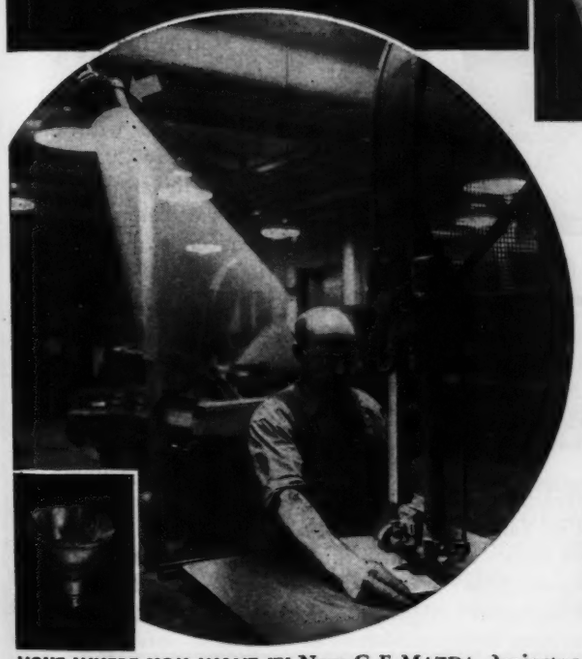


FLOUR MILL near Baltimore producing 400 bbl. per day has 251 hp. of motor load. 150 of which, shown here with meters, controls, etc., drives the main milling machinery

BEAUTY AND THE BEAST

both benefit from new G-E Sunlamp!

LADIES AND LITTLE PIGS both benefit from a new inexpensive G-E sunlamp, one of many new-type lamps recently developed by General Electric. Using scarcely more current than an ordinary 100 watt bulb, it provides three times as much ultra-violet as noon June sunshine. Tests show that ultra-violet speeds growth in pigs; cures rickets and builds sound bones and teeth in human beings.



LIGHT WHERE YOU WANT IT! New G-E MAZDA Projector lamp gives concentrated light where needed in stores, factories, and homes. A lens, reflector, and filament are combined in one heat-resisting all-glass unit.

SELLING BEGINS at home with Kraft-Phenix Cheese Corporation, whose Chicago office has been light-conditioned with 300 and 500 watt G-E MAZDA lamps [illegible] indirect light. How can G-E ligh[illegible]an.

DEATH CELL FOR LAMP BULBS is this G-E Lamp Development Laboratory, where enough G-E MAZDA lamps burn night and day to light a town of 4000. These life tests help assure the increasingly high standards set by G-E research and development . . . one of the reasons why G-E MAZDA lamps *stay brighter longer.*

Filling empty sockets

This ad is one of a new series G-E is running in Newsweek, Business Week and 11 industrial papers to sell Better Light for you.

G-E MAZDA LAMPS

GENERAL ELECTRIC

bagging machines, all of which contribute to flexible, efficient and economical production.

•

Infra-Red Halves Glue Drying Time

One of the troublesome problems in the manufacture of radio loud speakers is drying the glue that attaches the "voice coil" element to the speaker diaphragm. Usually this is done by passing the speakers through a convection oven on a conveyor belt. One disadvantage of this method of drying is that there is a tendency for the glue to dry only on the surface, leaving the inside portion spongy. With this condition slight jars to the speaker in later operations may displace the accurately aligned speaker coil, causing rejection of the unit.

Up until recently, when it installed a bank of infra-red drying lamps, between 20 and 25 minutes was required to dry glue on loud speakers in a convection oven at the plant of the Permoflux Corporation, Chicago. Now the same job is done in twelve minutes and production has been stepped up accordingly. The plant is now capable of producing 2,500-3,000 speakers per day per production line. There are two production lines now equipped with infra-red drying lamps; one line produces small diameter speakers, the other large.

As shown in the accompanying illustrations, the "small speaker" line is equipped with four groups of eight 260-watt, 120-volt carbon filament infra-red lamps in 7½-in. diameter reflectors about 6 or 7 in. above a 16-in. fabric belt that carries the speakers under the lamps at a speed of about 1¼ ft. per minute. The four banks are spaced about a foot apart on the line so that speakers can cool slightly between lamp groups and do not attain too high a temperature. They normally attain a temperature of around 120-130 deg. The mounting for the lamps is adjustable, permitting the lamp height to be varied to secure temperature control.

With the voice coil firmly glued to the speaker diaphragm, a small circle of felt is placed over it to keep out dirt. This "patch" is tacked into place with a little glue and coil leads covered with compound. This is quickly dried under a single row of eight lamps in 7½-in. reflectors at the extreme end of the line just before they pass into a booth for final testing and inspection.

FOUR BANKS of eight lamps over conveyor belt dry glue in twelve minutes on small diameter speakers

GLUE on felt seals is dried under these eight lamps above the same conveyor shown in above illustration

The second or large speaker line consists of two parallel 14-in. fabric belts each carrying speakers under a single row of seventeen 240-watt, 120-volt tungsten lamps in 10 in. gold-plated reflectors, mounted ⅛ in. above the belt. These lamps, as well as those on the small speaker line, are connected two in series across 220 volts.

•

Men's Store Goes Up to 50 Ft.-Candles

Dark fabrics in men's clothing leads to a need for correct lighting to assist the buyer in selecting right colors and weaves. And so Walter Swanberger remodeled his men's wear store in Santa, Ana, Calif. Modern lighting was installed and a substantial increase in business has resulted.

"Since moving to my new location my business has increased 27 per cent. I do not hesitate to attribute a large part of this business to the splendid lighting system in my new store," Mr. Swanberger says.

Twelve recessed fixtures, especially designed to harmonize with the architectural style, supply 20 to 50 ft.-candles throughout the store. Each fixture uses a 500-watt lamp and is equipped with lens control. Supplementary lighting from daylight fluorescent fixtures is used in fitting rooms and around mirrors.

Excellent show-window lighting is furnished from louvered troughs using 100-watt lamps on 12-in. centers. Fluorescent daylight lamps are used along the base of the windows to assist in bringing out the color of merchandise. Fifteen kw. of connected load in this new Swanberger location represents a 100 per cent increase in lighting demand over the former.

INCANDESCENT AND FLUORESCENT combine in this Santa Ana, Calif., men's wear store to produce 20-50 ft.-candles

*All refrigerator prices quoted are Dayton delivered prices; include installation, Federal Taxes and 5-year Protection Plan. Transportation, state and local taxes (if any), extra.

THE PRICE TAGS PROVE THE POINT

Frigidaire

BETTER THAN EVER FOR LESS THAN EVER!

THE PUBLIC is quick to sense outstanding value. Invariably, all other conditions being equal, buyers choose the greatest value for the money.

Low price alone may intrigue them. But the majority buy when low price is combined with exceptional quality.

That's why the Frigidaire Dealer has such a tremendous selling advantage. For the 1940 Frigidaire Appliances are *better than ever for less than ever.* And that spells "bargain" to hundreds of thousands of prospects.

They know the name Frigidaire stands for quality. They know the merit of General Motors products. And when a Frigidaire Dealer quotes prices way below any ever thought possible, they recognize the value and buy!

The price tags tell the story. Never before have genuine Frigidaires sold for so little money. Every model offers most for the money in its price class.

Yes, recognition of value is giving Frigidaire dealers their biggest year in history!

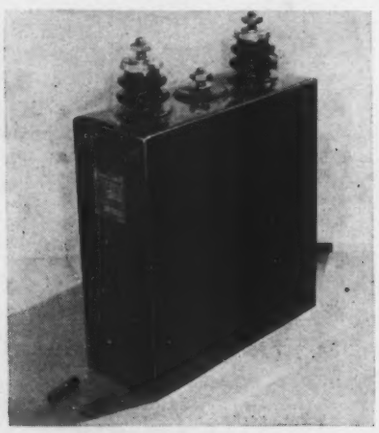
FRIGIDAIRE DIVISION
General Motors Sales Corporation • Dayton, Ohio

*All range prices quoted are retail prices, exclusive of local taxes and installation, in Dayton, Ohio, and many other cities. Proportionately low prices elsewhere.

NEW EQUIPMENT

Capacitors

Capacitor sections are made by winding a special grade of paper with thin copper foil. Foils are bonded on one end to the water tube so that they conduct heat to the water and carry the current. Leads



New line of water-cooled Inerteen capacitors, for high-frequency service on induction furnaces and similar applications. **Westinghouse Electric & Mfg. Co.**, East Pittsburgh, Pa.

are brought out at the center and the ground terminals of each group of sections is near the ends of the case. The complete unit is vacuum dried, impregnated and filled with capacitor "Inerteen," a non-inflammable fluid; in combination with the capacitor paper used it is said to be especially suited also as a dielectric for high-frequency applications.

•

Switch

New and improved Levolier switch. **McGill Mfg. Co.**, Valparaiso, Ind.

Company announces a new switch for fan assemblers and manufacturers of small motors with circuit control. The type of switch is not limited to one control. Other variations can be arranged.

•

Paper-Insulated Cable

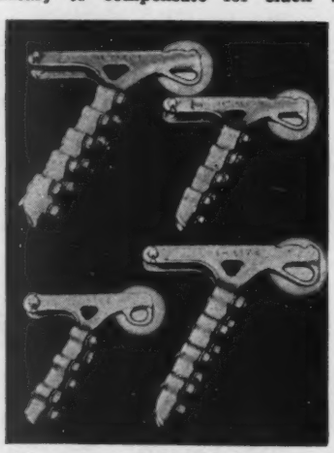
"Titebilt," new type paper-insulated cable. **Phelps Dodge Copper Products Corp.**, 40 Wall St., New York, N. Y.

A cable for electrical power transmission, it utilizes an improved insulation, said to give the oil-impregnated cable longer service life, higher impulse strength and better operating performance. The cable is made in single- and multi-conductor designs and in belted and shielded types. No special accessories or changes in ordinary joint and terminal designs are required. The new principle used in the design of this cable is said to eliminate the formation of voids.

•

"Hi-Lites"

This stringing loop under the nose of three of its strain clamps and called "Hi-Lites" makes it possible to attach the "blocks" for securing proper conductor tension directly in the clamp. When the tail block is hooked in the new loop and the conductor is brought to tension the entire dead-end assembly assumes a position that is practically a continuation of the conductor. Thus, it is said, it is not necessary to compensate for slack wire



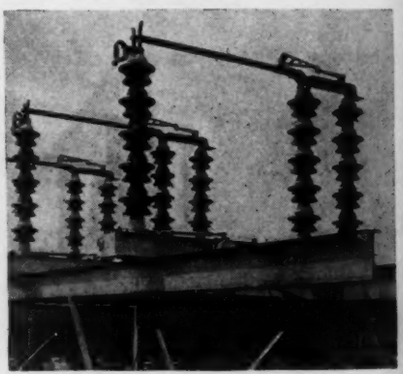
Three clamps redesigned have conductor ranges without liners of 0.400–0.680, 0.675–0.800 and 0.790–0.930 in., respectively; a fourth clamp without liners a range of 0.400–0.550 in., previously given a stringing loop. **Ohio Brass Co.**, Mansfield, Ohio.

between the come-along and clamp as required when the tail block is held by a sling placed around the pole or crossarm. The loop is an integral part of the clamp body casting.

WHO MAKES WHAT?—If it's electrical, look first in "Electrical World" *Electrical Buyers Reference.*

Outdoor Disconnects

Among new features for this switch is the new design gear drive for the blade, which is said to impart a steady harmonic motion and insure the blade being in positive control throughout the entire operating



New line of outdoor disconnecting switches, type "TTR-5," in all voltage ratings from 7,500 to 287,000. **Railway & Industrial Engineering Co.**, Greensburg, Pa.

cycle. After the blade reaches either the open or closed position it is automatically locked in that position and cannot be moved except by intentional movement of the control. All flexible connections have been eliminated and all contacts are the "Hi-Pressure" type. A new jaw design is said to give this contact without the use of back-up springs. Full contact is made with 7½ per cent overtravel or 7½ per cent undertravel of the operating mechanism.

•

Pipe Anticipator

Automatic pipe anticipator to forewarn excavator operator by an audible signal as his bucket approaches hidden underground service pipes of cables. **Wallace & Tiernan Products, Inc.**, Belleville, N. J.

This device is recommended for use in street excavation for installing or repairing pipe or cable lines, for electric power, communication, traffic signal, fire alarm; for subway, highway or street construction, and at power and industrial yards requiring excavation. It may be attached to any type of excavating or pushing machine. A continuous sound is produced which may be heard through either a loudspeaker or earphones. As the bucket of the excavator approaches a pipe or cable obstruction the sound volume increases.

YOU CAN'T "BEAT THE HUBBARD BAND"

when there's stubbing to be done

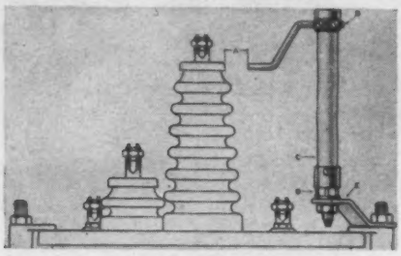
Furnished in all sizes for any diameter stubs and poles. Write Hubbard and Company, Pittsburgh, Pa., for complete data.

HUBBARD AND COMPANY

PITTSBURGH OAKLAND CALIFORNIA CHICAGO

Lightning Protector

This device is claimed to provide arc-snuffing, double-gap lightning protection for various types of single bushing or two bushing rural line transformers, where fuse cutouts are not used on the primary



"Protectogap," lightning protection for low-capacity rural line transformers; A, external air gap; B, external gap electrode; C, internal gap (inside the tube); D, discharge vent; E, adjustable bracket and ground. **W. N. Matthews Corp.**, St. Louis, Mo.

side. For use on low-capacity rural transformers, having internal fuses only. For two bushing transformers two "Protectogaps" are attached to the transformer top —one protecting each bushing.

•

Substation Light

Substation unit and mounting bracket redesigned to be dirt proof. Nos. 043386, 043776 and 0871. **Holophane Co., Inc.**, New York, N. Y.

The improvement for protection against dirt includes a snap-on rubber gasket for the bottom lip of the outer blown globe and a rubber gasket to go between the hinged and stationary members of the fitter. Three locking bolts pull the top tightly against the gasket to the bottom. The reflector sits on a heavy asbestos gasket. Company claims that cleaning once a year is sufficient.

•

Circuit Breaker

Combination switch and automatic circuit breaker which has the following features claimed for it: 'On' and 'off' manual switching plus automatic opening on overloads or short circuits; for switching and resetting after automatic opening, a rocker handle has been developed, thus eliminating the operating handle, which might become broken off; a red signal projects when the circuit has automatically opened.

"Circuit Master," a new circuit breaker with ratings from 15 to 50 amp. and 120 and 120-240 volts a.c. **Bull Dog Electric Products Co.**, Detroit, Mich.

Air-Conditioner Control

New magnetic switch for control of air-conditioning equipment motors directly from the contacts of room thermostat or other low-voltage control instrument. **General Electric Co.**, Schenectady, N. Y.

Control consists of a three-pole magnetic switch mechanism, overload relays and a low-voltage control transformer assembled into one unit. The new magnetic switch and transformer combination is said to protect a motor against overload and, because its low-voltage control terminals are on the outside of the inclosure, it is claimed to assure isolation of the pilot circuit from the power wiring.

•

Pilot Relay

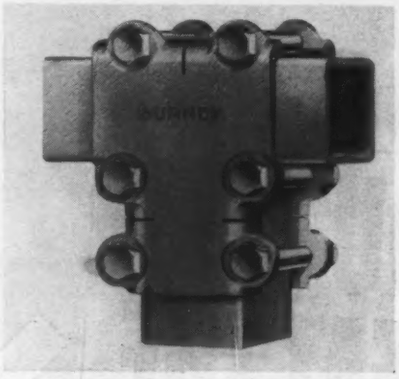
Pilot relay, an electronic switch for control of large currents by delicate mechanisms, liquids or extremely light contact pressure. **Photoswitch Inc.**, Cambridge, Mass.

Control is effected by the delicate touching of two fine wires or contacts, or by their being short-circuited by a liquid or moist material. To be used with contacts on meter relays, sensitive temperature controls, electrical recording equipment, electrical precision gauges, electrical flow meters, etc.

•

Connector

Clamping pressure is exerted on the corners of the tube and thereby buckling



Special connector type TNT, a complete line of electrical connectors and bus supports for square tubular bus, both ventilated and unventilated types. **Burndy Engineering Co., Inc.**, New York, N. Y.

of the tube walls is claimed to be prevented. Types available for joining cable, round tubing, flat bar or other conductor forms to square tubing.

•

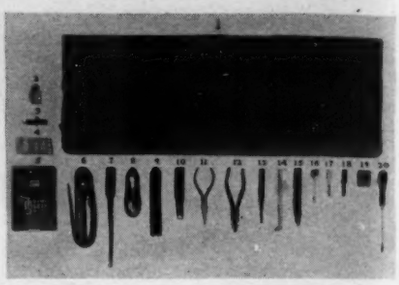
Meter Cleaner

Cleaning machine for meters, timers and stop watches. **Superior Cleaning Machine Co.**, Pittsburgh, Pa.

Motive assembly comprises a.c.-d.c. Dumore motor, speed-control rheostat, bevel reduction gears driving tubular shaft and drive rod. There are three heavy glass jars, rectangular in shape, claimed to prevent solution riding with basket. The drying chamber has a disk type heating element and reflector. A thermal type switch automatically shuts off heater current or entire machine when parts are dried.

Tool Kit

The following items are included in this tool kit with a special compartment arranged for each item: (1) Canvas roll, (2) bottle of jewel oil, (3) ball dropper, (4) package of pith, (5) mahogany cabinet



Meter and relay tool kit for the testing of meters and relays. **The States Co.**, Hartford, Conn.

with compartments for jewels and bearings, (6) cover wrench to handle glass cover, (7) 9½-in. screw driver, (8, 9) combination fuse puller and circuit tester with leads, (10) 5-in. insulated socket wrench, (11) long nose cutting pliers, (12) 6-in. side cutting pliers, (13) tweezers, (14) offset screw driver, (15) magnet cleaner, (16) oil dropper, (17) ⅜-in. socket adapter for ½-in. insulated wrench, (19) fuses, (20) ½-in. screw driver.

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TECHNICAL LITERATURE

FLUORESCENT LAMPS — Gives essential technical data on fluorescent Mazda lamps and auxiliary equipments. Incorporates information on all the auxiliary equipment necessary for fluorescent lamp operation. Contains a table on power-factor correction and connection diagrams. Available from General Electric Company, Nela Park Engineering Dept., Cleveland, Ohio.

ARC WELDING ELECTRODES—An illustrated 24-page booklet, No. ADW-18, issued by the Wilson Welder & Metals Co., Inc., 60 East 42d St., New York, N. Y., has been prepared as a useful guide in helping to select proper electrodes for all classifications of welding work. The final section of the booklet is devoted to "Welding Symbols and Instructions for Their Use."

NICKEL ALLOYS—"Seven Minutes With Seven Metals" includes material on nickel, monel, inconel and associated alloys in both mill and clad forms. In this sixteen-page, pocket size edition space is devoted to the properties and uses of the metals in cast form. Three pages are devoted to detailed tables on mechanical, chemical and physical characteristics. Distributed by the International Nickel Co., 67 Wall St., New York, N. Y.

CLASSROOM LIGHTING — "Recommendations for Classroom Lighting" includes recommended standards for classroom lighting as well as a discussion of other factors influencing school lighting, such as chalk boards, painting and wiring. Attention is also given to the influence of adequate lighting in classrooms. Room-by-room relighting as well as lighting of the new school are considered. Copies may be obtained from the F. W. Wakefield Brass Co., Vermilion, Ohio.

JUST OUT!

NEW G-E WATER HEATER SALES PRESENTATION BOOK

Nothing else like it! Done in the new pictorial style. Tells and sells in an interesting and effective way. Get a sample copy *today*.

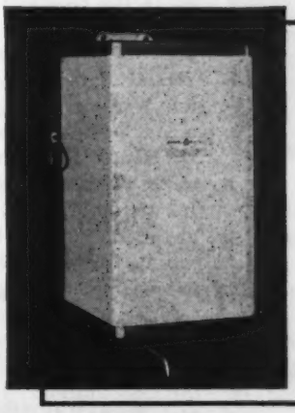
. . . PLENTY OF SALES AMMUNITION FOR YOU

General Electric *writes* in *pictures* the powerful new selling story of G-E Water Heaters! Here's the way to talk to water heater prospects and sign 'em up. . . . Simply leaf through the new G-E Sales Presentation Book and watch interest lead to desire and action! It's a winner for stimulating water heater sales.

JUST ONE OF MANY NEW G-E WAYS TO MORE WATER HEATER BUSINESS

Ask your G-E Distributor to show you *all* of General Electric's new sales "props" and plans to get more water heater business this year . . . . See the sensational new sales film "We Like It Hot"—see the new "pictogaph" Sales Manual—see the new Wall Display Chart and Visualizer—see the new G-E Heater-Meter. All yours for more sales! Get the complete story *now*.

General Electric Appliance & Mdse. Dept., Bridgeport, Conn.



- The General Electric Water Heater line is *complete*. Sizes for every need—from 2 to 140 gal. capacity, Rectangular, round, table-top, wall-type models. Monel or galvanized. Single or twin units. (Popular-priced "Rocket" pin-up model illustrated).

All G-E Water Heaters have the famous CALROD *immersion-type* heating units. Calrod heats water by direct contact, cheapest electrical method known. Durable; will not scale or rust.

GENERAL ELECTRIC

NEWS ABOUT PEOPLE

A. W. Higgins Named Head of Southeastern Group

Albert W. Higgins, newly elected president of the Southeastern Electric Exchange, has devoted a period of nearly thirty years to the utility business and at least an equal number of years of progressive activity in civic and trade associations.

Mr. Higgins was born in Boston, Mass,. in 1880. He was graduated from Massachusetts Institute of Technology in 1901, with a degree in chemical engineering.

Upon leaving college, his first posi-

tion was with the Sayles Bleacheries, Saylesville, R. I. Other engineering positions followed until 1912, when he became associated with the American Public Utilities Co. at Grand Rapids, Mich., and from this time on his business activities have been centered in utility operations and executive management of operating properties.

For several yeais he was president of the Virginia Public Service Co., with headquarters at Charlottesville, and the Seaboard Public Service Co. at Alexandria.

Since 1936 Mr. Higgins has been president of the Florida Power Corp., serving Florida's West Coast, with headquarters at St. Petersburg, and the Florida Public Service Co., serving central Florida. He is also vice-president of the Georgia Power & Light Co., serving the southern part of Georgia.

•

▶ HOWARD BOYLAN has been appointed assistant to the president of the Nevada-California Electric Corp., Riverside, Calif. Mr. Boylan has been with the company for seventeen years, most of the time in the position of cost accountant in the construction department. A. B. West is president of the company.

▶ RUSSELL POE has been appointed purchasing agent of the West Penn System. Mr. Poe was purchasing agent of the Wheeling Traction Co. when the West Penn System took over the property in 1911. When it was decided to centralize purchasing in the Pittsburgh office, in 1916, he was made assistant purchasing agent of the system.

▶ WENDELL L. WILLKIE, president of Commonwealth & Southern Corp., was made the recipient of one of the gold medal awards of the National Institute of Social Sciences at the society's annual dinner held recently at the Hotel Waldorf-Astoria, New York. The medal was presented to Mr. Willkie by Dr. Frank Kingdon, educational director of Citizenship Educational Service, Inc., after William E. Hall, president of the institute, had read a citation extolling Mr. Willkie as an "outspoken defender of individual freedom and enterprise who, by his speeches and writings, has made a vital contribution to the maintenance of government under the Constitution." Dr. Kingdon praised Mr. Willkie for performing a distinct service to democracy in his warnings against concentration of power in either industry or government, his insistence on civil liberties and the open nature of his fight against TVA competition in the utility field.

Herbert W. Clough Elected Belden Vice-President

Herbert W. Clough has been elected vice-president in charge of sales of the Belden Manufacturing Co., Chicago. This promotion comes to Mr. Clough after eighteen years of service with Bel-

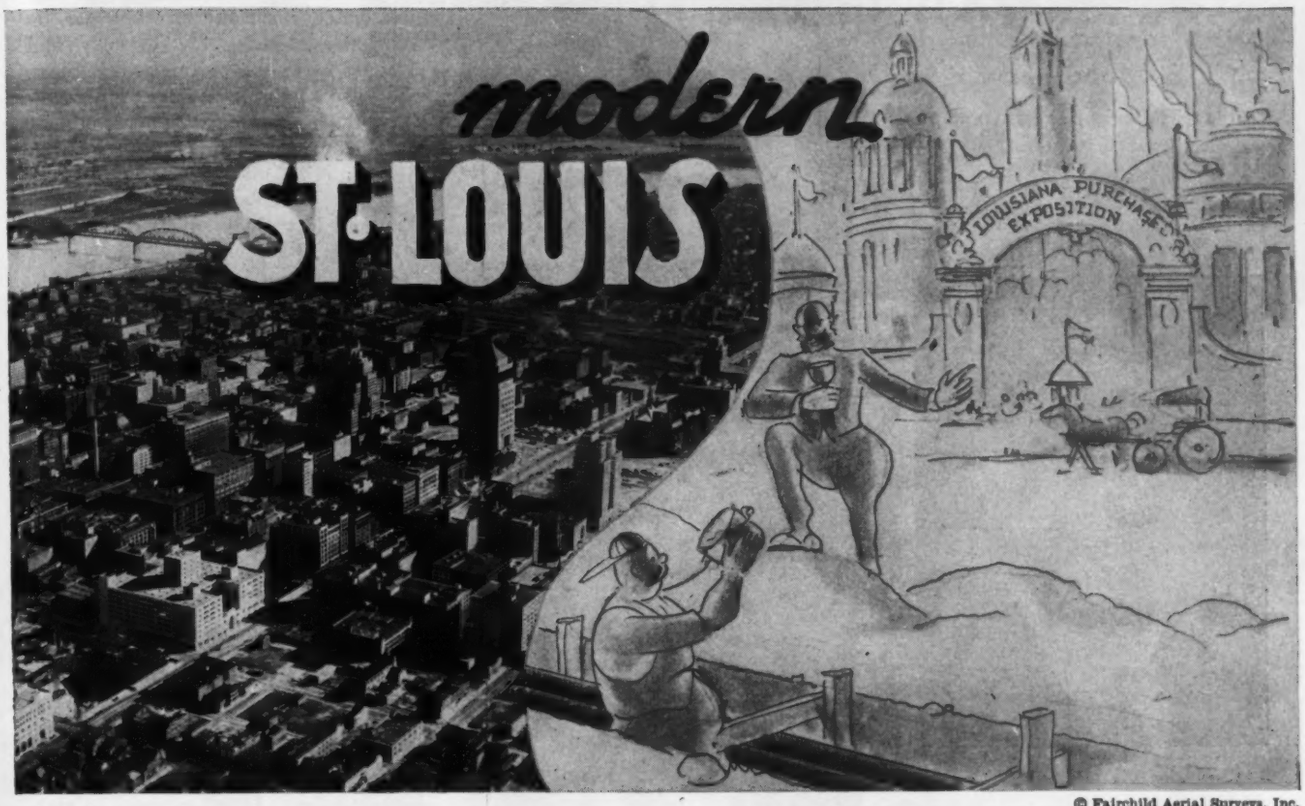
den. In the course of this association he has been in close contact with many fields of industry.

After serving in the production division and inside sales department, he represented the company as salesman in the Chicago district and later supervised government orders and Canadian sales. Then he was made manager of merchandise sales. About a year ago Mr. Clough succeeded Whipple Jacobs as general sales manager when Mr. Jacobs was elected president.

•

▶ JAMES D. FLEMING has been appointed vice-president and sales manager of Grinnell Co., Inc., Providence, R. I. Previous to this appointment Mr. Fleming was vice-president and manager of the Grinnell Co. of the Pacific, a subsidiary. He has been associated with that company since 1919. He will

ORANGEBURG HAS *long* BEEN PART OF



© Fairchild Aerial Surveys, Inc.

"Underground" electrically speaking, in St. Louis is partly the coordinated duct installations of separate companies. Over a million and a half feet of ORANGEBURG installed during the second decade of the century by each of these companies are in service today. Genuine "ORANGEBURG" is real cable insurance when cables are installed underground.

• ORANGEBURG announces another development to effect savings in conduit installation costs—a new and improved portable tooling lathe for use on the job.

This lathe will do those things ORANGEBURG users told us they wanted to accomplish—accurately tooled joints—a time saving over other methods of making joints—for use on all sizes 2" to 6" inclusive both *Standard* and *Nocrete*—cutters easily resharpened — reclaim short lengths and thus reduce waste on the job.

This lathe is priced low ($40 complete, as illustrated, Cat. No. 0900) so as to encourage its use. Buy one for your next job and see for yourself the improved quality of the joints and the savings it will effect.

Sales Agent—Distributors

GRAYBAR ELECTRIC COMPANY INC.

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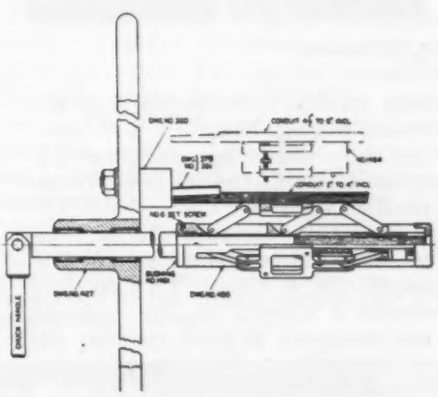
GENERAL ELECTRIC SUPPLY CORP.

Made at Orangeburg, New York by the Fibre Conduit Company 292 Madison Ave. New York City



ORANGEBURG *Standard* for installation *with* concrete encasement
NOCRETE for installation *without* concrete encasement

continue to manage the Pacific company, but will be located at the company's home office at Providence.

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North American Calls Ralph E. Moody East

Ralph E. Moody has been appointed assistant to the president of North American Co., New York, and has resigned positions held with Wisconsin subsidiaries of that company. He had

R. E. Moody

L. F. Seybold

been assistant to the president of Wisconsin Electric Power Co. and executive vice-president and director of Wisconsin Gas & Electric Co. and Wisconsin-Michigan Power Co.

Stanley B. Sherman, Racine, vice-president and general manager of Wisconsin Gas & Electric Co., has been elected a director of that company and designated as chief operating officer, succeeding to duties previously performed by Mr. Moody.

William E. Schubert, Appleton, vice-president and general manager of the Wisconsin-Michigan Power Co., has been elected a director of that company and designated as its chief operating officer.

W. E. Schubert

S. B. Sherman

Lawrence F. Seybold, Milwaukee, a vice-president of the Wisconsin Electric Power Co., has been elected vice-president also of Wisconsin Gas & Electric Co. and of Wisconsin-Michigan Power Co.

Since June of 1913 Mr. Moody has been employed by the Wisconsin Electric Power Co.

•

▶ A. H. SHETTLER has been elected comptroller of the Union Electric Co. and subsidiaries and the St. Louis County Gas Co. Mr. Shettler, a certified public accountant, has been associated with Price, Waterhouse & Co. for sixteen years.

▶ WILLIAM C. STONE, system operator, electric department, Public Service Electric & Gas Co., Newark, N. J., was made the recipient of the "Thomas N. McCarter Electric Award" at a recent meeting of the Public Service Electric Association in Newark. Mr. McCarter, chairman of the board, made the presentation. The award, a medal and an engraved certificate, is to be presented annually to the employee in the company's electric department who has contributed most during the year toward the increase of efficiency and progress of that department. Mr. Stone was selected for the prize "in recognition of his initiative, perseverance, courage and foresight in connection with the rebuilding of the electric facilities at the Essex, Kearny and Marion stations and City Dock substation."

OBITUARY

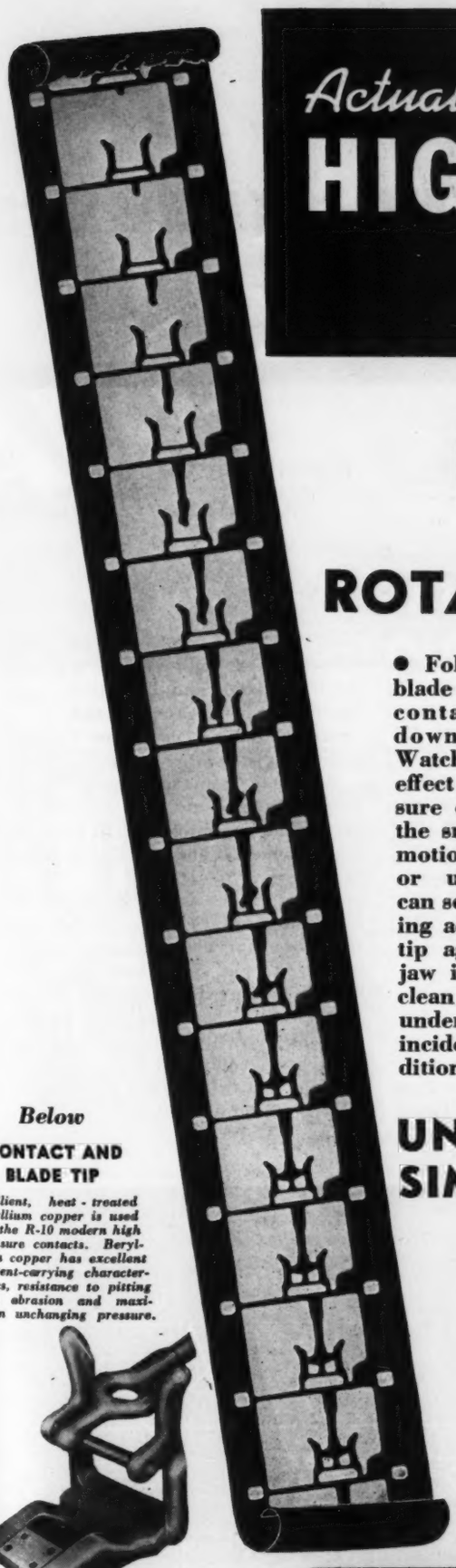
Percy H. Knight

Percy H. Knight, prominently identified with the electrical engineering industry for a number of years, died May 3 at Costa Mesa, Calif. Mr. Knight was a heroic figure in the engineering profession, having won the admiration of the entire industry for the courage he showed following a ghastly accident which deprived him of both his hands and badly injured his legs and feet. The accident occurred while he was engaged in the construction of a power house for the Snoquelme Construction Co. at Seattle, Wash., of which he was superintendent. In an endeavor to save some of his men who had been subjected to an electric current of 66,000 volts, through the failure of insulation, which electrified the roof trusses on which these men were working, Mr. Knight was subjected to the full force of this voltage. His life, subsequent to the tragic accident, was a striking example of personal fortitude which carried him above the overwhelming afflictions which he faced and surmounted for the subsequent third of a century.

Mr. Knight was born in Mayville, N. Y., in 1868. He was graduated from Cornell University in 1892 with M.E. and E.E. degrees. He was identified for a number of years with the Westinghouse Electric & Manufacturing Co. at East Pittsburgh and in 1900 became superintendent of the Snoquelme Construction Co. at Seattle. After spending two years in the hospital following the accident, he returned to the Westinghouse company. Some years ago Mr. Knight moved from his home in western New York to California.

•

▶ IRA W. HENRY, consulting engineer, and president of the Ionizing Corp. of America, New York, died April 25 in Greenwich, Conn., after an illness of a year. His age was 70 years. Mr. Henry was a life member of the American Institute of Electrical Engineers.



Actual **MEMCO MOVIES** *Show the*

HIGH PRESSURE CONTACT

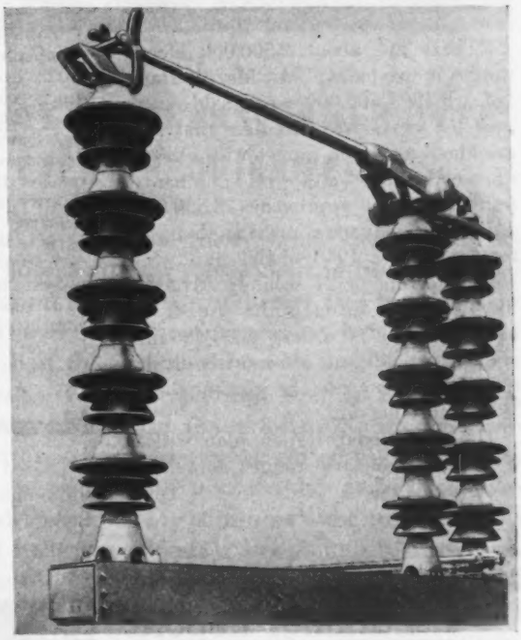
of the improved

MEMCO R-10

Vertical Break

ROTATING TYPE SWITCHES

● **Follow the switch blade as it enters the contact jaw on its downward motion. Watch it rotate and effect the "high pressure contact." Picture the smooth, continuous motion with no jolting or unevenness. You can see how every rotating action of the blade tip against the contact jaw insures a lastingly clean contact surface under all climatic or incidental chemical conditions.**



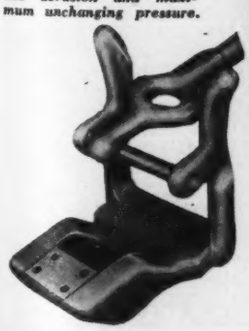
UNFAILING SIMPLICITY

Simplicity and strength with a minimum of parts characterize the Memco R-10 switch. Careful counterbalancing of moving parts assures ease of operation. The smooth powerful motion imposes an irresistable shearing or bending stress that easily cracks ice or sleet. The well rounded stream-lined effect makes the switch corona proof. Unfailing operation even under severe weather conditions makes the R-10 design preferred by engineers everywhere.

Below

CONTACT AND BLADE TIP

Resilient, heat - treated beryllium copper is used for the R-10 modern high pressure contacts. Beryllium copper has excellent current-carrying characteristics, resistance to pitting and abrasion and maximum unchanging pressure.



● **SEND FOR BULLETIN, NO. 401-A. Gives complete data, drawings, photos, voltage ratings and other information you need to get a complete picture of this simple, rugged, reliable switch. Send for your copy today.**

"Specify **MEMCO** *Switchgear"*

MEMCO ENGINEERING & MANUFACTURING CO., Inc. LONG ISLAND CITY, N. Y.

MANUFACTURING - MARKETS

Hotpoint Offers New Electric Range Unit

A nation-wide campaign for the modernization of old electric ranges by the installation of 1940 Calrod equipment was described to ELECTRICAL WORLD this week by D. C. Marble, manager product service division, Hotpoint.

"There are about 2,500,000 electric ranges in use today," Mr. Marble stated, "of which 1,500,000 were sold in the past ten years. We calculate that there are about a million ranges with old-style open-coil units and the number of units probably approaches 3,500,000."

Utilities may now provide their customers with a 1940 model unit which starts cooking in 27 seconds, Mr. Marble said, and through the use of one of only eight stainless steel adapter rings practically all old models of electric ranges may now be equipped with 1940 units, he said.

The new modernization plan will be restricted to electric ranges actually in use by customers.

•

Manufacturers Issue Earnings Reports

Electrical manufacturing companies, which have recently issued statements of operations covering the March quarter, include the following:

COPPERWELD STEEL—Net profit for first quarter, $227,687, equal after preferred dividend requirements to 45 cents a share on 431,714 common shares, compared with $200,177, or 46 cents a share, in the first quarter of 1939. Construction of the steel plant at Warren, Ohio, is rapidly nearing completion, S. E. Bramer, president, stated at the annual meeting. Stockholders approved the reservation of 30,000 common shares for sale to officers and employees.

SQUARE D—Net profit $400,858, after provision for federal and state taxes and other reserves, equal to approximately 89 cents a share on outstanding 421,360 shares of common stock, after deducting $25,000 for dividends on preferred stock. This compares with a net profit of $120,600 for first three months of last year upon the acquisition of the Kollsman Instrument Co., Inc.

BLAW-KNOX — Orders booked approximated $4,130,000, an increase of 34 per cent over the $3,083,000 total for the March quarter last year. Shipments were about $4,805,000. against $2,893,000, up 66 per cent. Unfilled orders on March 31 amounted to $4,108,000, compared with $2,986,000 a year earlier.

BABCOCK & WILCOX and wholly owned companies, net profit, $829,565, equal to $1.23 each on 671,970 shares of capital stock, contrasted with net loss last year of $512,690. Company's equity in profits, less losses, of companies more than 50 per cent owned amounted to $152,838 in first quarter this year, against $35,277 in same quarter a year ago. No dividends were declared by such companies in either period.

ANACONDA WIRE & CABLE—Preliminary report shows net profit of $129,280, equal to 31 cents each on 421,981 common shares, contrasted to net loss of $77,161 last year.

•

Moves to Connecticut

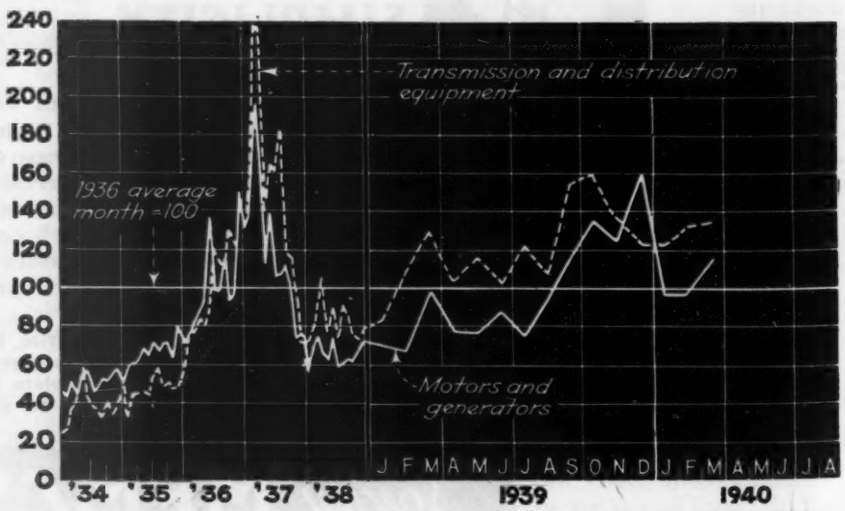
United Cinephone Corp. announces the removal of its offices and plant from Long Island City, New York, to larger quarters at Torrington, Conn.

Electrical Orders Continue Advance

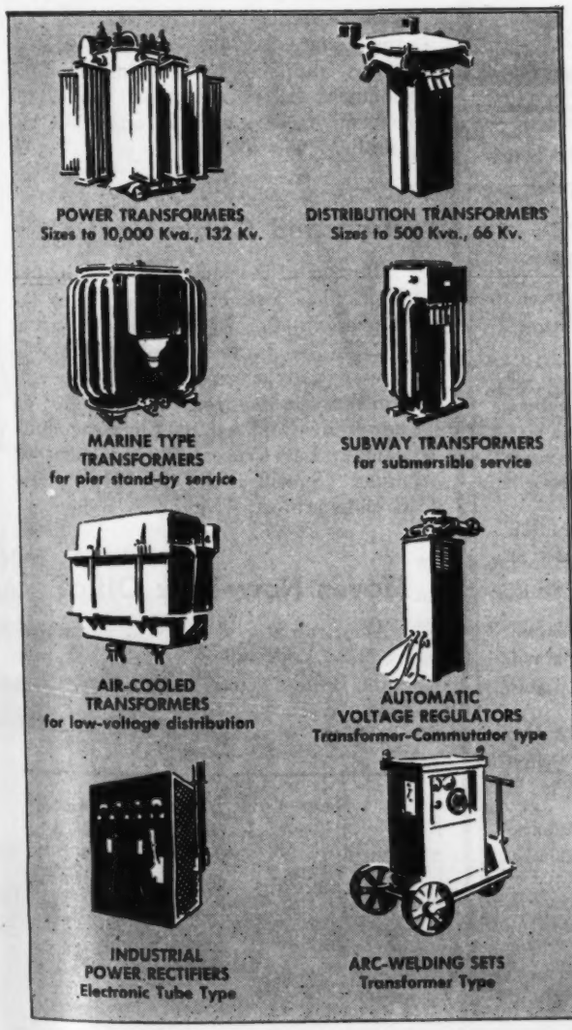
Orders received for electrical equipment continued to gain in March, with the NEMA index for motors and generators rising to 115.9, a gain of 18.4 per cent over February and of 16.7 over March a year ago. The NEMA index for transmission and distribution equipment moved sidewise to 133.8, an increase of 0.8 per cent over February and of 3.6 per cent over March, 1939.

Percentage gains last year for March over February were 46.5 per cent for motors and generators and 19.3 per cent for transmission and distribution equipment.

Averaging the index series for the first quarter of 1940 gives a figure of 103.7 for motors and generators, approximately 32 per cent above the corresponding figure for 1939, but 33 per cent under the figure for 1937, the previous high year. For transmission and distribution equipment, the average is 129.3 for the first quarter this year, 22 per cent ahead of 1939, but 29 per cent behind 1937.



NEMA INDEX, value of orders received for motors (large d.c., polyphase, synchronous) and generators (engine, belt-driven); also for transmission and distribution equipment



A DIVERSITY OF TRANSFORMER TYPES TO MEET EVERY REQUIREMENT . . .

Before making a purchase many firms demand information as to where similar equipment is in actual use. To customers and prospects who desire this type of data concerning AmerTran Transformers no better example can be cited than the major shipyards and government naval stations*. With the present rush to build ships, transformer equipment in these locations receives the most severe industrial usage, being called upon in many cases to operate twenty-four hours a day at full load for weeks on end. Moreover, it is almost sure to receive its full share of heavy overloads. Products illustrated on the left are among the many types of AmerTran equipment supplied to shipbuilders. Let us submit data on similar transformers for your needs—transformers designed to withstand the abuses of heavy industrial service.

* Names on request.

AMERICAN TRANSFORMER COMPANY
178 EMMET ST., NEWARK, N. J.
Manufactured Since 1901 at Newark, N. J.

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Hot Rolled Copper Rods • Bare and Tinned Strand
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(In Rounds, Flats and Squares)
URC Weatherproof Wire
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That New, Tough, 60% Jacketed, Heavy Duty Portable Cable

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5 Reasons

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1 The Greenlee Hydraulic Bender will bend conduit easier and faster, cutting your labor costs to a minimum. One man can easily and quickly develop the pressure needed to bend conduit.

2 By bending your conduit right on the job with the Greenlee, you save the cost of many manufactured bends and fittings.

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Write for Complete Details

GREENLEE TOOL CO., 1705 Columbia Ave., ROCKFORD, ILL.

Manufacturers Make Sales Appointments

New sales assignments have recently been announced by manufacturing companies:

Anderson Brass Works, Birmingham, Ala., has announced that J. E. Anderson, vice-president, has taken over responsibility for the southwestern territory with headquarters at 707 S. Ervay Street, Dallas, Tex.

Terry Steam Turbine Co., has appointed the Northwestern Power Equipment Co., 2295 University Avenue, St. Paul, Minn., as sales representative for Terry turbines, gears and turbo-generator units.

Easy Washing Machine Corp. has announced the appointment of J. A. Grady of Ridgewood, N. J., as district manager in charge of the state of New Jersey and K. H. Dowd has been named to take charge of the northern Michigan area.

•

Hygrade Sylvania Files

Hygrade Sylvania Corp., Salem, Mass., has filed a registration statement with the SEC for 83,000 shares of no-par common stock. The stock is to be offered pursuant to a plan of recapitalization whereby holders of $6.50 convertible preferred stock of the company will have the right to exchange their shares for the common stock on terms supplied by amendment. Any common shares not issued under the exchange offer, may be offered to the public.

•

Awarded Cable Contract

Bureau of Reclamation, Washington, D. C., has awarded a contract to the Aluminum Co. of America, Inc., at $57,468 for furnishing aluminum conductor and accessories for the new transmission line from the hydro-electric power development at Elephant Butte dam to Las Cruces, N. M., about 62 miles (Specifications A-8959-A), Rio Grande project.

•

Moves New York Office

American Steel & Wire Co. has moved its New York office from the Empire State Building to 71 Broadway, New York, N. Y.

New York Metal Prices

	May 14, '40 Cents per Pound	May 8, '40 Cents per Pound
Copper, electrolytic	11.50*	11.125*
Lead, A. S. & R. price	5.00	5.00
Antimony	14.00	14.00
Nickel, Ingot	35.00	35.00
Zinc, Spot	6.14	6.14
Tin, Straits	54.00	47.50
Aluminum, 99 per cent.	19.00	19.00

*Delivered Connecticut Valley.

FINANCIAL STABILITY of "Ocean and Columbia" Power Plant policies is amply backed by present assets . . . by a 60 year record of never having failed to pay a just claim . . . by sound capital stock financial structure . . . by a long background of sound insurance methods . . . all of which are essential to boiler and machinery protection

ENGINEERING SERVICE is effective when it prevents accidents *before* they happen. That's where "Ocean and Columbia" experts fit into your picture. Licensed inspectors, they bring with them a rich experience gained in many types of power plants . . . backed by special training in the works of leading manufacturers. Flaws or faults that may escape the attention of plant engineers absorbed in operating problems are detected almost unfailingly by the methods, instruments, and skill of "Ocean and Columbia" experts. "Every man to his last" . . . these "Ocean and Columbia" Engineers *specialize* in the *prevention* of Boiler and Machinery failures.

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An "Ocean and Columbia" analysis of *your plant . . . your hazard . . .* is available without obligation.

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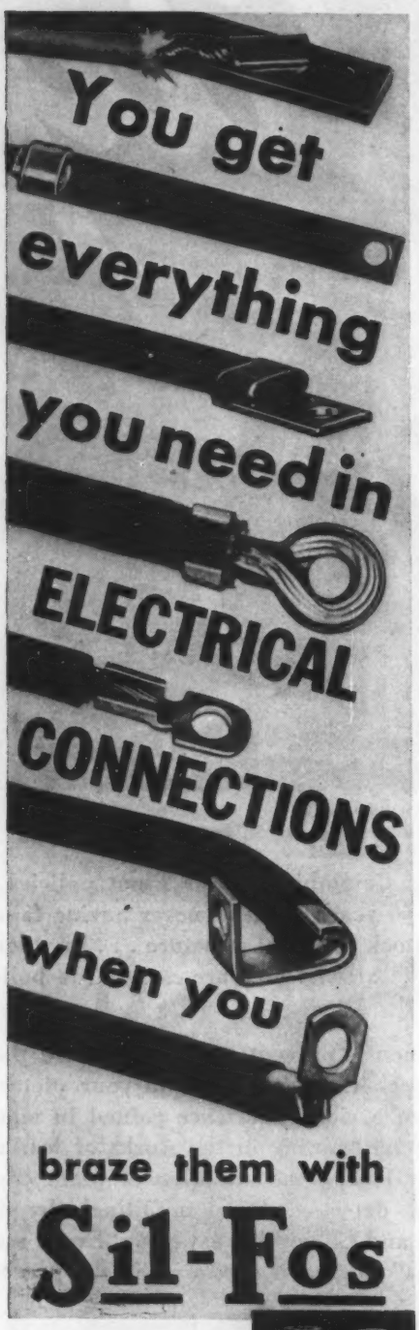

You get joints like solid metal in STRENGTH and DUCTILITY to withstand shock, vibration and temperature changes . . . you get joints that equal or surpass the metals joined in ELECTRICAL CONDUCTIVITY and resist corrosion . . . and because of the exceptional fluidity, low working temperature (1300 Deg. F.) and small amount of Sil-Fos needed to make a joint, you get all these advantages at surprisingly LOW COST PER JOINT. If the brazing of lugs, terminals, connectors, taps, wires, cables or bus bars is part of your production or maintenance, it will pay you to TRY SIL-FOS. Get full details—Write today for Bulletin EM-55.

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Field Reports on Business

The spread of the European war has had a depressing effect on business, security and commodity markets. It is expected that some foreign markets will be lost. Domestic business is showing signs of further expansion. Utility construction and activity are expanding. Appliance sales show further gains.

NEW YORK

Depressing conditions prevailed in all markets this week as the war spread throughout Europe. Security prices tumbled to new lows for the year and commodities were under pressure. Opinion is that foreign trade will be disrupted and some markets lost. There is likelihood of a speeding up of defense plans in this country which will soon be reflected in domestic production.

Opinion is growing that the sharp rebound in steel operations indicates domestic industrial recovery is more substantial than otherwise shown by other indexes. Automobile production is running higher than originally expected. Residential building activity is at the highest level in a decade. Utility construction is being speeded. A further gain in the index of general business is shown in the Pittsburgh area.

The TVA has awarded contracts to Allis-Chalmers for a hydraulic turbine and governor and to Westinghouse for a generator for installation Pickwick Landing Dam. Westinghouse received a contract for high-intensity mercury units to light the 6.6 miles of tunnels on the Pennsylvania Turnpike. Other manufacturers report incoming orders are for diversified line of products and equipment.

Outlook for the utility industry is becoming brighter. Power production is holding well and earnings are increasing.

PACIFIC COAST

Major appliance sales in northern California, a typical large area, show decreases of 20 per cent in unit sales of electric ranges for 1940 thus far below those of the same period of last year and similar decreases of 6 per cent in ironers, 25 per cent in major air heaters and 30 per cent in water heaters. Unit sales increases reported are 1½ per cent for cleaners, 5 per cent for washers and radios, 20 per cent in auxiliary air heaters (due to a colder winter), and 45 per cent in refrigerators, this last item breaking about even in dollar value because of a 33⅓ per cent price decrease somewhat offset by larger sales of larger sizes.

Record-breaking totals of building permit volume, with a marked absence of larger projects and a noticeable emphasis upon frame dwellings, are providing good contracting business and excellent prospects for smaller appliances. Pacific Coast lumber mills are especially heavy buyers of electrical machinery. Their present production is 15 per cent over 1939 and 40 per cent over 1938. Recent low machinery bids include $94,600 for four 13,333-kva. Moloney transformers and $47,825 by Railway & Industrial Engineering Co. for a 16,500-volt reactor assembly, all for unit A9 of Boulder plant, and $426,800 by Allis-Chalmers for four 30,000-kva. transformers and $248,000 for ten 10,000-kva. Moloney transformers, these being for Parker Dam plant in Arizona. Cutler-Hammer was awarded a contract for generator controls costing $69,085 and Allis-Chalmers metal-clad switchgear equipment, value $99,607, for Grand Coulee plant.

NEW ENGLAND

Several large awards for electrical equipment stand out above a steady trend in orders placed in this district during the past week. Six 250,000-kva. circuit breakers for a 15-kv. line have been purchased here recently; Westinghouse received orders for marine propulsion and control apparatus totaling about $125,000 from the government to be delivered at one of the navy yards in this area a short time ago. Recent government cable contracts have been received by Collyer Insulated Wire Co., Pawtucket, R. I., $7,211, and Rockbestos Products Corp., New Haven, Conn., $7,269.

A representative of a prominent motor manufacturer reports about 30 per cent gain in orders to date as compared with last year. He comments on a very wide application, noted in inquiries, and cites steady buying by machine tool builders and pump manufacturers.

Steam plant expansion in this district is active and carrying with it some interesting electrical equipment. Fort Allen, Vt., is to install a new boiler with forced draft, together with automatic combined feedwater system, and demands for overhead automatic fuel feed equipment are steady; recently one manufacturer placed three orders totaling about $9,000 in these units for New England plants.

Air-conditioning installations in the Boston Edison territory gained 26.7 per cent in number and 27.4 per cent in horsepower in 1939 as compared with 1938.

CHICAGO

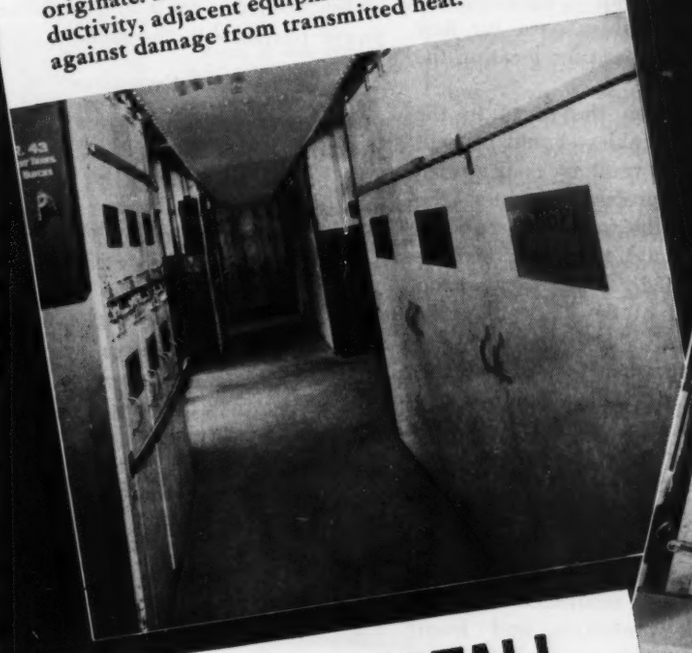
Developments during the past week gave further evidence that a period of stabilization has been reached in business throughout this area. Industrial activity increased over a wider front, with manufacturers reporting sales and earnings well ahead of last year. Steel mill operations in this district increased sharply, with prospects for further gains more than likely. Electric power output advanced from the previous week to widen the margin of gain over a year ago to 10 per cent.

Despite the unseasonal weather, retail trade continued to increase over the level a year ago. Electric appliance sales are reported to be from 10 to 25 per cent ahead of last year at this time. Of 32 manufacturers reporting April sales to the Electric Association, 22 showed an increase over March and 28 registered a gain for the four months of this year over 1939. All of the electrical wholesalers reported an increase in sales in April over March as well as for the year to date.

Electrical contractors report considerable pick-up in the number of jobs on which they are figuring. A sizable amount of electrical equipment is involved in expansion and remodeling projects by some of the large packing companies. International Harvester Co. plans to erect an addition to its East Moline plant at a cost of approximately $1,000,000, including a large amount of electric apparatus. The city electrical department has requested bids on 700 25-watt pole-mounting type transformers.

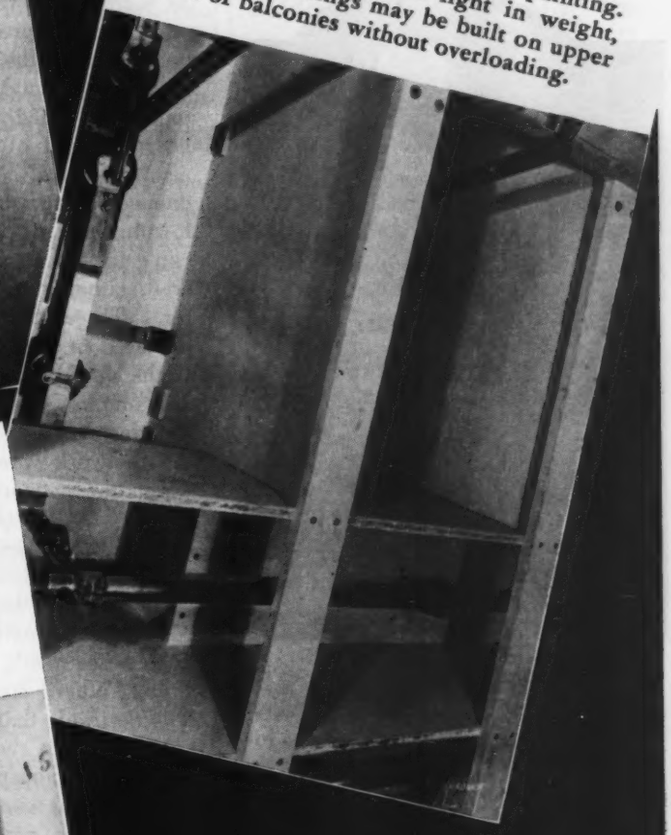
SAFE

You eliminate fire risks when you build cell structures and doors of J-M Trancell. An asbestos product, this J-M material cannot burn under any conditions . . . oil fires are confined to the cells in which they originate. And, because of its relatively low conductivity, adjacent equipment is better protected against damage from transmitted heat.



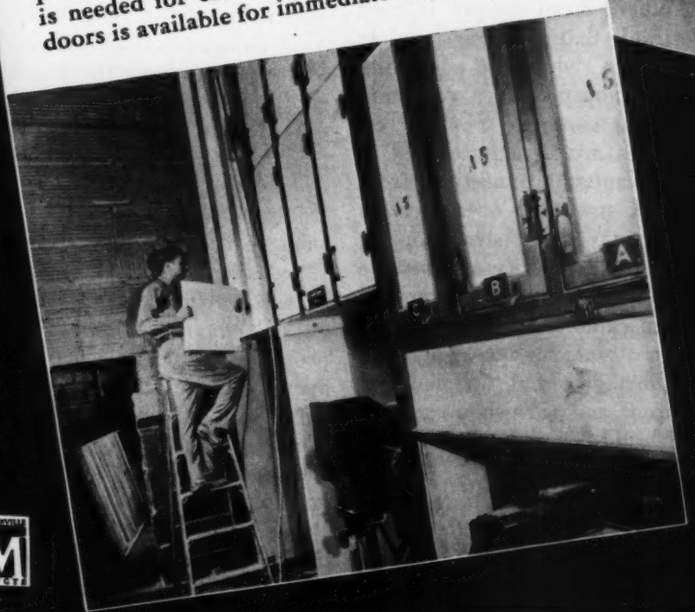
STRONG

Tough and durable, J-M Trancell needs little or no maintenance. Warpage is minimized. Trancell cannot rust or rot . . . never causes shutdowns for cleaning or painting. And because Trancell is light in weight, equipment housings may be built on upper floors or balconies without overloading.



EASY TO INSTALL

The large, ready-to-use sheets of J-M Trancell are easily worked and handled. Jobs are completed rapidly with ordinary tools . . . no water is needed for erection. Hardware for Trancell doors is available for immediate shipment.



Full details will show you how you can make stations safer . . . and save money at the same time . . . by building with J-M Trancell. Write for brochure DS-426. Johns-Manville, 22 East 40th Street, New York, N. Y.

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AN ASBESTOS PRODUCT FOR BETTER CELL STRUCTURES AND DOORS

for high compression at low torque

● There's no such thing as slippage inside the new streamlined Fargo "6000" Connector. At low torque its vise-like grip holds conductors in perfect, permanent contact. Fargo high compression at low wrench torque assures maximum pressure between conductors with less possibility of damage to threads. That's one reason why you can expect extra years of service and more repeat use from Fargo "6000" Connectors. Now available in No. 6 and No. 4 sizes, with other sizes available later.

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DISTRIBUTED BY
LINE MATERIAL CO.

Vaults for A.C. Secondary Networks

[*Continued from page 47*]

duct banks enter the vault varies from 12 to 96 in. and the average is 68 in. There are many variables entering into the determination of where the ducts are brought into the vault, such as the location of existing duct banks and available space for new ones, available space for locating the vault, etc.

In going from the ducts to the equipment the cables should be kept as high in the vault as is practical, and should preferably enter the equipment at the top, so as to keep them dry should the vault become partially flooded. When they are up near the roof of the vault they are also less likely to be accidentally damaged than when they are racked low on the vault walls. The primary cable in almost all cases is lead covered, either single- or three-conductor. Three single-conductor cables are used in about 60 per cent of the vaults studied. In multiple-unit vaults a secondary bus is used, to which the transformers are connected through the network protectors and from which the network ties and customers' services are tapped. This bus is usually made of strap copper or varnished cambric fireproof braid-covered cable suspended from the roof, and it should be so constructed as to be as nearly fault-proof as possible. Where strap copper is used it is desirable that it be barriered or taped so as to reduce the possibility of faults resulting from a vault fire or accidental contact. Similar secondary buses are sometimes used in single-unit vaults. Connections from the network protector or protectors to the bus may be of strap copper, but in the great majority of cases are cable. Almost every known type of low-voltage cable is used in making these connections, such as paper and lead, rubber covered, triple-braid weatherproof and varnished cambric fireproof braid covered.

Illumination and Safety

Adequate illumination should be provided to permit test and maintenance work in the vault either day or night. A light switch should be provided convenient to each entrance opening. Lighting fixtures should be fastened either to the roof or the walls near the roof in a position where they will illuminate the equipment and working space, but where they will not be easily broken. Two 60- or 100-watt lamps will usually furnish sufficient illumination for a single-unit vault. When wiring the vault for lighting a single-phase outlet, and sometimes a three-phase outlet, is often provided for the operation of motor-driven tools and for other power purposes in the vault.

Fires and Explosions

In locating, designing and constructing network vaults all reasonable precautions should be taken to decrease the possibility of fires and explosions and to minimize the resulting damage if they do occur. Transformers filled with a non-inflammable insulating and cooling liquid go a long way toward eliminating vault fires and explosions, and it is this fact that has resulted in the great increase in their use in network vaults during the last few years. Where the vent openings into the vault are in the wall, as is often the case when a vault is designed for forced ventilation, and sometimes the case when natural ventilation is used, dampers have in some cases been put in the vent openings. Dampers are normally held open through a fuse which, when a vault fire occurs, melts and allows the dampers to close, thus cutting off the ventilation in an attempt to smother the fire and reduce the amount of flame or smoke that will pass out the vents to the street. This damper arangement, of course, in no way reduces the possibility of explosions or their resulting damages.

Collection of explosive gas in a properly ventilated network vault in sufficient quantity to cause any trouble is very unlikely; however, such an accumulation of gas is possible. In a vault where there is reason to believe explosive gas may be encountered a subway network protector should be installed. If an open type protector is used an arc, due to its tripping or one or more of its fuses blowing, may ignite any gas which is present and cause a fire or explosion.

The grating-covered openings in the roof of a vault, in addition to providing the necessary ventilation, decrease the probability of the vault walls breaking when a transformer explosion occurs if they are of sufficient area and properly located. Tests made in connection with grain dust

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...AND THAT'S HOW RELAY DEPENDABILITY IS ASSURED

There is one right way to buy relays; that is, to make sure they are designed right in the first place, then specifically adapted to your application. This is where Dunco comes into the picture in a big way. Backed with one of the largest lines of quality relays, timers, etc., and with years of practical experience in fitting them to the specific needs of leading users, Dunco engineers are in an enviable position to help you get the most for your relay dollars in terms of dependability and long, trouble-free performance. Write for the Dunco Relay Book—free upon request.

STRUTHERS DUNN, Inc.

1319 Cherry Street, Phila., Pa.

DUNCO *RELAYS*

explosions indicate that where the vault is not a cube the vent area must be distributed so that each cubical unit has its recommended share of vent area. A relation has been found between the data on dust explosions and explosions of gas resulting from electric arc decomposition of insulating oil. From this relation it has been determined* that the net vent opening to protect 6-in. thick reinforced concrete walls against breakage when a transformer explosion occurs is 4.8 sq.in. or more per cubic foot of vault volume. The corresponding figure for 8-in. thick concrete walls is 2.1 sq.in. or more per cubic foot of vault volume. This protection of the vault walls against breakage due to a transformer explosion by properly located vents of adequate net area is especially important where the vault is on or adjacent to a customer's property and has one or more walls common with the customer's building.

*"Considerations In Network Transformer Manhole and Vault Design," by T. D. Reimers, presented before subject committee on underground methods and accessories, transmission and distribution committee, E.E.I., Rochester, N. Y., on February 8, 1939.

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REA Allots Funds for Three Systems

Allotments totaling $179,000 for rural electrification systems in three states have been announced by Harry Slattery, Administrator of Rural Electrification. Details of the allotments follow:

MINNESOTA—Minnesota Valley Co-operative Light and Power Association, Granite Falls, Oscar W. Swanson, supt., $55,000 to build about 68 miles of line to serve 145 members in Lac Qui Parle County. The project previously has been allotted $398,000 to build 378 miles of line to serve 753 members in Chippewa, Lac Qui Parle, Yellow Medicine and Swift Counties, and $35,000 to finance house wiring and plumbing installations.

OREGON—Malheur Co-operative Electric Association, Vale, C. S. Harris, correspondent, $30,000 for construction of a generating plant. This project previously has been allotted $108,000 to build 115 miles of line, to serve 347 members in Malheur County and $10,000 to finance house wiring and plumbing installations. Jordan Valley Electric Co-operative, Inc., Jordan Valley, Sam R. Scott, president, $18,000 to build 4.5 miles of line to serve 81 members in Malheur County. For the construction of a generating plant, $12,000.

SOUTH CAROLINA—Santee Electric Co-operative, Inc., Kingstree, Walter E. Blackwell, supt., $64,000 to build about 36 miles of line to serve 167 members in Williamsburg and Clarendon counties. The project previously has been allotted $100,000 to build about 134 miles of line to serve 215 members, and $10,000 to finance house wiring and plumbing installations.

STRENGTH, ruggedness and durability are combined with definite economy in *Crapo* Galvanized Steel Strand. Low first cost, low maintenance expense are matters of record wherever this time-tested product is in use. Available in all standard grades and sizes from representative jobbers throughout the country. Or, write—

INDIANA STEEL & WIRE CO.

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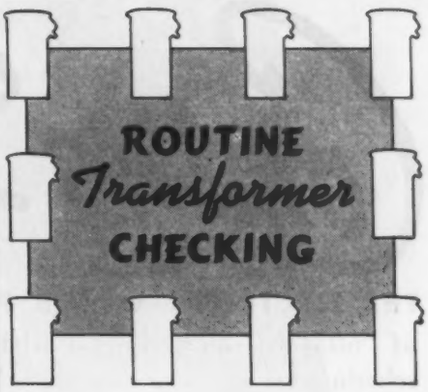

Makes it possible to use fewer transformer sizes to meet all loads

Having a complete picture of load conditions on the entire circuit, you know at once which transformers are being overloaded and which are not serving to approximate capacity. Therefore, you can, by using the transformers already in service, change the location of certain transformers to meet the load needs and save the cost of purchasing and carrying an extra supply of transformers.

ANOTHER POINT: finding defective equipment

As a result of routine transformer checking, your crew, doing this important job, is able to find defective equipment such as broken primary and secondary transformer bushings, defective lightning arresters, open or broken ground leads, etc., which might otherwise remain on the line. This gives you an opportunity to keep the system cleared of defective equipment enabling savings in service interruptions and trouble costs.

Find out other benefits realized through routine transformer checking. Write for bulletin.

HD
MAX-I-METER

The MAX-I-METER is a modern, lightweight, weatheproof, maximum-demand ammeter combined with a multi-range split core current transformer—4 ratios—which clamps over the conductor. No connections to make. No trailing leads. Ready for instant use—no support necessary. Accurate to 3% plus or minus. Not affected by ambient temperature. Can be easily reset and used immediately.

HD ELECTRIC CO.

100 W. MONROE ST. CHICAGO

Coming Soon

THE ELECTRICAL WORLD PREMIERE of "605-Million Dinner-Pail-Dollars" is scheduled to open on your desk in the June 1, 1940 issue. As you know, this presentation will show American industry *"how widely and how deeply the biggest electric utility construction program in a decade will affect the national economy."*

To give you a glimpse of some of the facts and figures which this feature will bring you, we have arranged with the producers for this preview.

You'll see 17 picture-packed "reels" like these in the June 1, 1940, Edison Electric Institute Convention Issue of ELECTRICAL WORLD . . . besides a dozen pages of charts, graphs and other data showing what these "dollars" mean to the nation as a whole—and to you as an individual.

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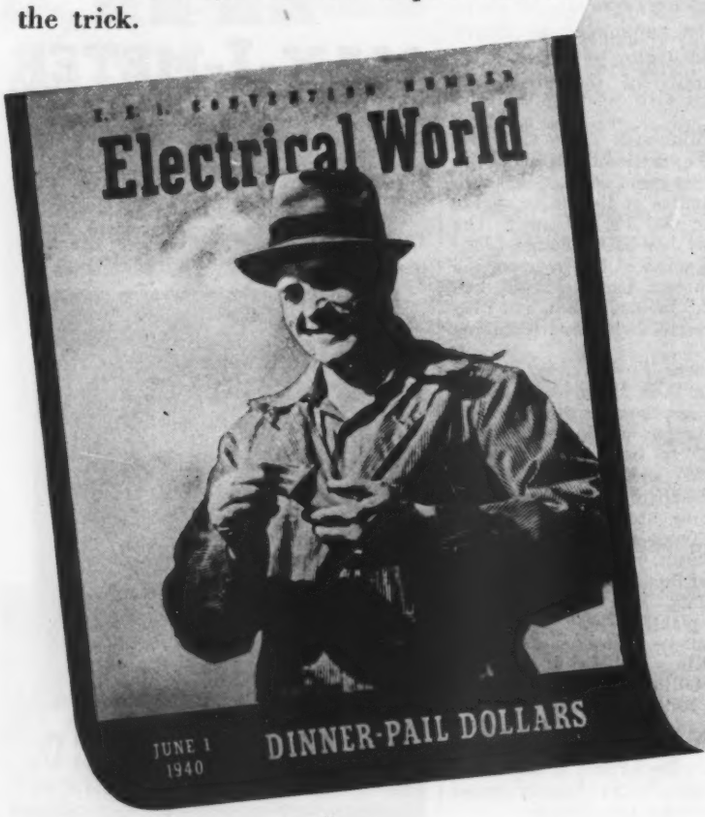

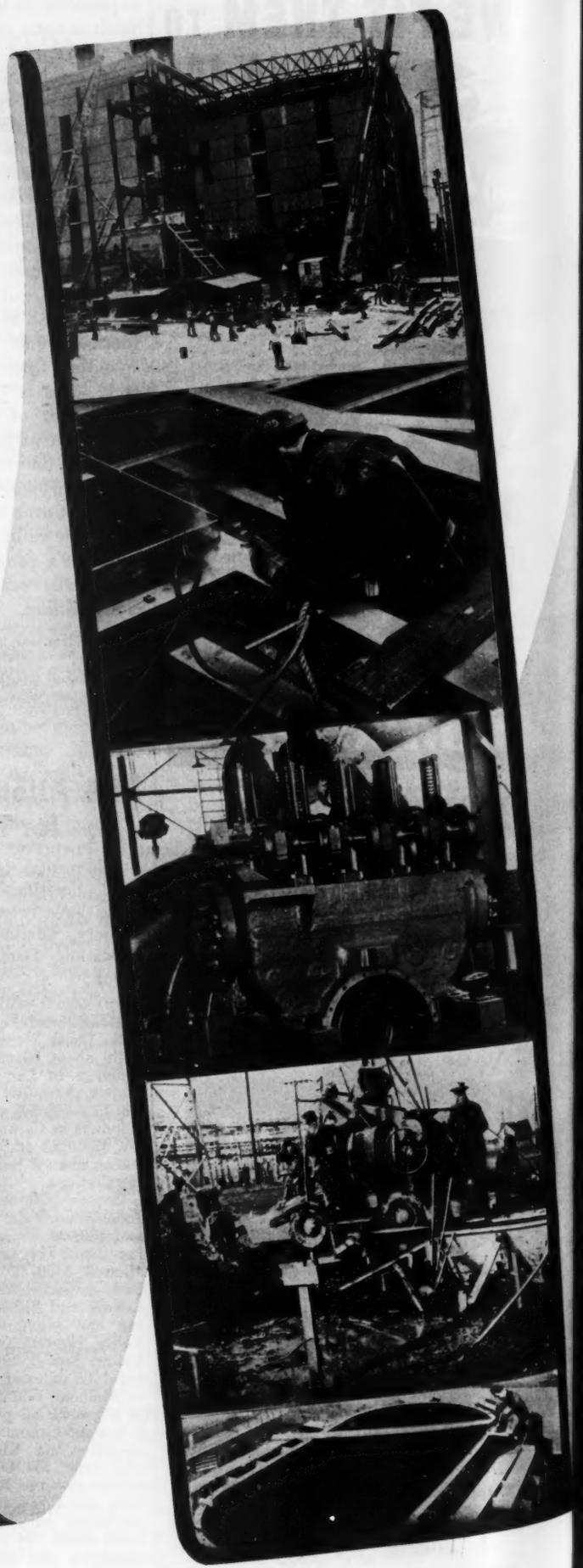

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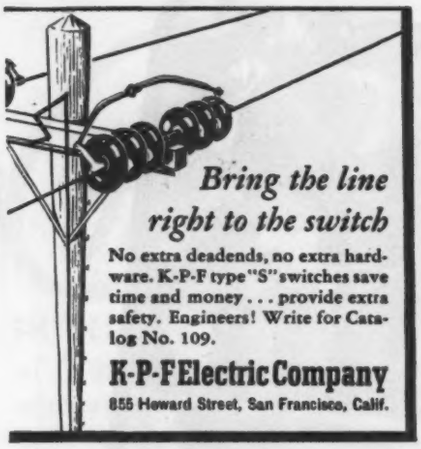

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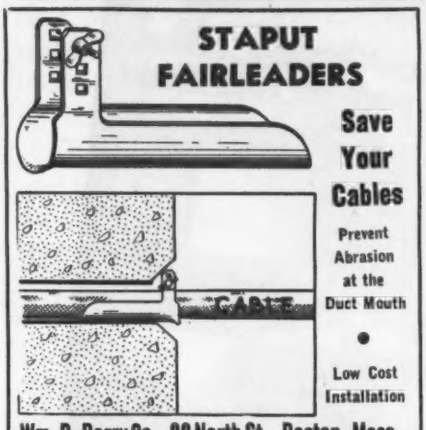

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Activated Aluminum Holds Quality in Insulating Oil

[*Continued from page 57*]

reduced in proportion to its use for filled bushings is transferred to the reactivator after being discarded for business service. Material from breathers which may be accidentally oil soaked can be transferred to the reactivator and need not be lost. The activated alumina in use for several years at Alcoa has shown no material loss in capacity except in the bushing applications, where the loss of moisture adsorption ability results from the high (900 deg. F.) reactivation temperatures experienced in reactivating oil-soaked material. Special technique is required in treatment and reactivation methods for oils of higher viscosity than insulating oil.

The difficulty inherent in the central treating system is twofold: First, the oil is permitted to rise to a high neutralization number before treatment is given; second, there is the problem of transporting large quantities of oil, sometimes from a great distance, to a central point. With this method the possibility of having to remove equipment from service at an inopportune time may exist. This is a disadvantage which does not exist in the case of the thermal-circulation treater, as it is serviced by merely closing external valves.

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The program set up at Alcoa seven years ago has achieved its objective, which may be stated simply as the development of a method for the preventive maintenance of oil. This method eliminates the problem of sludged transformers or other oil-using apparatus and eliminates moisture from all housings which either contain oil or which may be affected adversely by moisture.

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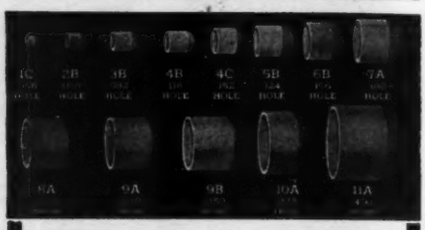

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difficulties, is easily mastered by the maintenance crews already assigned to duties of like nature and, after it is once installed, requires no added labor or skilled supervision.

Of paramount importance is the increase in the amount of time that the transformers are available for service since they now do not require untanking for cleaning. A desirable decrease in amount of time out of service for cleaning and servicing bushings on oil circuit breakers and transformers has resulted. A substantial saving in time and material has come about as the result of the elimination of oil filtering operations where activated alumina breathers have been applied.

•

Recent Rate Changes

NORTHERN PENNSYLVANIA POWER CO., Towanda, has filed new schedules with the state Public Utility Commission calculated to effect a saving of not less than $113,190 annually to customers other than power users. Last October power users received a rate reduction. Under the new rates, which are effective for all billings resulting from meter readings after April 30, annual savings to residential consumers total $65,000.

WASHINGTON WATER POWER CO. has put into effect a $300,000 rate reduction in eastern Washington and northern Idaho. The reduction, which became effective April 25, will affect all classes of residential and commercial service, with steps of the rate designed to encourage greater use of electric service by customers who have been in the lower use brackets. Reduction in the minimum was made in the case of small towns, where the minimum became 14 kw.-hr. for 80 cents instead of 16 for $1, and in rural areas, where the minimum became 14 for 90 cents instead of 16 for a dollar. In Spokane the minimum remained the same, with the next step dropping from 4 to 3.5 cents. Smaller towns dropped from 4.5 to 3.5 cents and rural areas from 5 to 3.9 cents. Succeeding steps in the rate are progressively lower to 210 kw.-hr. of use, where a rate of 1.5 cents for all additional use becomes effective, with water heating at 7 mills. Commercial rates were reduced to compare favorably with residential rates. "This latest reduction is the result of several factors," said J. E. E. Royer, vice-president and general manager of the company. "First is the increased use of electric service by our customers. This has been stimulated by the sales efforts of a trained organization co-operating with electrical dealers throughout the Inland Empire. It resulted also from our continuing policy of adopting new and improved methods of operation. Furthermore, it reflects our policy of passing on to our customers any savings. The saving in bond interest resulting from our bond refunding last summer is one such saving. . . . Under these new rates, our customers now can enjoy more of the benefits of electric service at rates lower than ever before."

WEST COAST POWER CO. has filed with the Oregon Public Utilties Commissioner rate reductions in two small districts in Oregon. By these reductions the electric users in Burns, Ore., will save $7,000; those in the Clatskanie district, involving 450 customers, will save $3,500. The new rates became effective with billings on and after May 15.

UNION ELECTRIC CO. of Missouri has announced reductions in electric rates for street lighting in 48 communities in Missouri, Illinois and Iowa. William McClellan, president of the company, said the reductions would save the municipalities about $40,000 a year on the basis of present service.

•

Municipal Plants

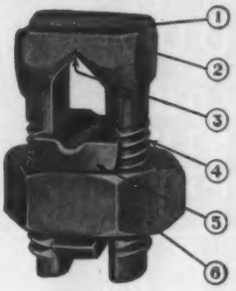
ZIEGLER, ILL.—Voters recently defeated a proposed municipal plant and condemnation of Central Illinois Public Service Co.'s distribution facilities by a vote of nearly three to one with 1,250 of the 1,700 registered voters of the city going to the polls. The vote totaled 918 opposed to the municipal plant to 328 for.

OELWEIN, IOWA—Voters recently rejected for the second time in eight years a proposal to construct a municipal light and power plant in that city. The vote was 1,659 against the proposal and 1,177 for. Interstate Power Co., with headquarters in Dubuque, Iowa, has served the community of Oelwein with electric service for the past 22 years.

ST. CHARLES, MO.—Proposition for a municipal power plant was defeated for the third time on May 4. Needing a two-thirds majority to win, the advocates for the measure fell 426 votes short of their goal—the most severe setback they received in the three elections. The vote was 1,745 for the proposal, 1,511 against. The proposition voted on was the issuance of $600,000 in bonds to finance construction of a municipal electric generating plant and construction or purchase of an electric distributing system.

On May 7 the Missouri Supreme Court refused to halt ouster proceedings in the St. Charles County Circuit Court against the Union Electric Co. of Missouri. The Supreme Court did not comment in denying the application of the company for a writ of prohibition to prevent Circuit Judge Edgar B. Woolfolk at St. Charles from continuing with the charter forfeiture case filed by Prosecuting Attorney David A. Dyer of St. Charles County. The suit to revoke the company's charter and prevent it from doing further business in Missouri was filed last April by Prosecuting Attorney Dyer. Last March Judge Woolfolk overruled a motion filed by the company as a plea in abatement. It attacked the jurisdiction of the court in the case because the Union Electric's main offices are in St. Louis and not in St. Charles. Following Judge Woolfolk's adverse ruling, the company applied to the Missouri Supreme Court for the writ of prohibition which was just denied. The case now goes back to the St. Charles court for trial on its merits.

NELSON, NEB.—Nebraska Supreme Court has issued an injunction against the city at the request of the Southern Nebraska Power Co. to prevent it from continuing construction of its own power system. City Council has contracts with Fairbanks, Morse & Co. to build a plant for $40,842. The question is whether the law invoked requires an election and approval by the voters or whether this is unnecessary. The injunction is to be in force until this question is decided by the court.



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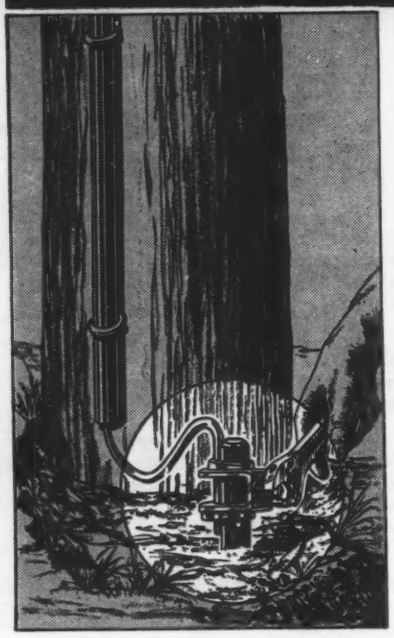

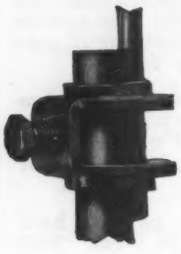

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ELECTRIC COMPANY
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What, Where and How of the New Building Wires

[*Continued from page 54*]

three conductors normally carrying current in the conduit, then No. 14 heat resistant grade can be used. In this case the Code takes care of voltage drop by rating down the conductors. It is interesting to note in the above that nine No. 12 RHT conductors require inch conduit, hence could not be used. It is necessary to use nine No. 10 SN or RU conductors to install the circuits in ¾-in. conduit.

20. ***(Q) Should voltage drop be figured entirely on a 50° C. basis or should it be figured at 60° and 75° C. depending on the wire used?***

(A) Unless 60 or 75 deg. wire is chosen deliberately to operate at or near those temperatures normally, the usual method of determining voltage drop should be satisfactory. Frequently, these higher quality conductors are specified and used underloaded to obtain a better job. Table VI indicates the effect on resistance drop of operating a selected group of wires at 50, 60 and 75 deg. C. with the maximum currents permitted for not more than three conductors in a raceway at an ambient of 30 deg. C. The effect of the higher loading at higher temperatures is roughly a 50 per cent increase in resistance voltage drop between 50 and 75 deg. C. operation. Under these circumstances voltage drop should be determined at the operating temperature. A review of various drop tables and calculators indicates considerable vagueness regarding the temperature base used and correction factors. It is suggested that these items be checked if any one table is now regularly employed.

Table VII indicates the increase in resistance voltage drop when the conductor size for a given current is reduced by using the higher quality conductors and operating them at limiting temperatures. It will be noted that the drop practically doubles. Hence the higher current values permitted for the better quality conductors must be used with great caution if length of run or the current flowing makes voltage drop important.

Tables and curves giving 50, 60 and 75 deg. C. ohmic resistances and resistance drops for various conductors and loadings are not readily available. However, voltage drop at a given temperature can be calculated from any wire resistance table if the temperature on which the table is based is known, together with the coefficient of change applicable at that temperature. Table XVII of the 1940 Code shows resistances per 1,000 ft. at 15 deg. C. For this base the temperature coefficient is 0.393* per cent per deg. C. for 98 per cent con-

*National Bureau of Standards Circular 31—Copper Wire Tables

Table VI—Effect on Resistance Drop and Reactance Drop of Operating Wires to Full Capacity at 60 and 75 Deg. C.

Reactance based on three-phase, 60-cycle circuit—phase to neutral

Wire Size	Temp. °C	Amp 3 in 1 Conduit 30°C Ambient	A.C. Resistance Ohms per 1,000 Ft.	Reactance Ohms per 1,000 Ft.	Resistance Drop — Volts per 1,000 Ft.	Reactance Drop — Volts per 1,000 Ft.	Impedance Drop — Volts per 1,000 Ft.
12	50	20	1.81		36.2		
	60	23	1.87		43.0		
	75	27	1.96		52.8		
6	50	45	0.449	0.050	20.2	2.25	20.3
	60	54	0.465	0.050	25.1	2.70	25.2
	75	65	0.489	0.050	31.8	3.25	32.0
1/0	50	105	0.113	0.042	11.9	4.41	12.7
	60	127	0.117	0.042	14.9	5.33	15.8
	75	151	0.123	0.042	18.6	6.34	19.7
4/0	50	160	0.0577	0.0388	9.24	6.20	11.1
	60	193	0.0597	0.0388	11.5	7.49	13.8
	75	230	0.0628	0.0388	14.4	8.93	16.9
500 MCM	50	265	0.0260	0.035	6.90	9.28	11.6
	60	319	0.0270	0.035	8.62	11.20	14.1
	75	382	0.0283	0.035	10.8	13.40	17.2

Table VII—Effect on Resistance Drop and Reactance Drop of Reducing Wire Size for Same Current and Operating at 60 and 75 Deg. C.

Reactance based on three-phase, 60-cycle circuit—phase to neutral

Amp.	Wire Size	Temp. Deg. C.	A.C. Resistance Ohms per 1,000 Ft.	Reactance Ohms per 1,000 Ft.	Resistance Drop — Volts per 1,000 Ft.	Reactance Drop — Volts per 1,000 Ft.	Impedance Drop — Volts per 1,000 Ft.
100	1/0	50	0.113	0.0425	11.3	4.25	12.1
100	1	60	0.146	0.0438	14.6	4.38	15.2
100	3	75	0.239	0.0450	23.9	4.50	24.3
200	300 MCM	50	0.0414	0.0375	8.28	7.50	11.1
200	250 MCM	60	0.0510	0.0375	10.2	7.50	12.5
200	3/0	75	0.0783	0.0400	15.7	8.00	17.6
400	1,250 MCM	50	0.0119	0.0350	4.76	14.0	14.8
400	750 MCM	60	0.0188	0.0350	7.52	14.0	15.9
400	600 MCM	75	0.0240	0.0350	9.60	14.0	17.0

ductivity copper. (Code current carrying capacities are based on copper of 98 per cent conductivity). Resistance at another temperature can be calculated from the equation:

$$r = r_{15} \times (1 + 0.00393)\ (t - 15)$$

where r = resistance at the desired temperature

r_{15} = resistance from Table XVII at 15 deg. C.

t = new temperature at which the resistance is desired.

Since volts drop equals current times resistance, the drop per 1,000 ft. of wire is readily determined. Knowing the length of circuit in question, the drop encountered can be readily figured.

21. (Q) Is it necessary to include reactance drop in figuring total voltage drop?

(A) Not to any greater extent than is now done in proper design of circuits in raceways. Reactance drop is usually neglected in single-phase calculations and in three-phase calculations unless the currents and wire sizes are substantial. Tables VI and VII indicate impedance drops for the cases quoted. The impedance drop is the vector or graphic sum of the resistance and the reactance drop. It will be noted that it is negligibly greater than the resistance drop alone for the smaller currents and conductor sizes.

E.E.I. Engineers Explore Problems at Chicago

[*Continued from page 45*]

life of poles now being set, even though it involves a treated arm. Kiln-dried arms will presumably be acceptable if dried in accordance with lumber industry standards.

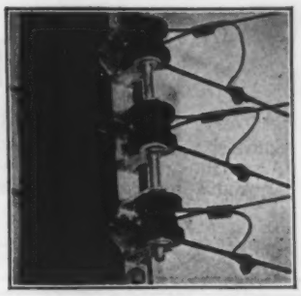
To reduce replacement schedules to a matter of two per year for all types of street lamps the joint E.E.I.-N.E.M.A. committee on street lighting is proposing, reported W. B. Elmer (Boston Edison), to put all lamps up to 10,000 lumens on a 3,000-hour laboratory life basis. Another proposal is to have equal mean lumens for both series and multiple lamps instead of the differential now due to the ratings on initial lumens. Some hitch has been encountered in the effort to standardize on the metal and glassware components of high efficiency units because the manufacturers want to conform only on new designs. Series sockets and receptacles are close to agreement.

Definitions for "utilization voltage" terms received attention again and Stanley Stokes (St. Louis) reported that Westinghouse has developed (at $75 for each of the first 24 sold) an E^2 meter in a portable standard watt-hour meter case; it requires no resistance load and gives five-minute maximum and minimum voltages. The attendant proposal to develop separate lines of three-phase motors for application to three-wire, 240-volt and four-wire, 208-volt systems brought dissent from W. R. Bullard (Ebasco Services) based on many years of satisfactory results with performance of a single line on both voltages. There is also the economic balance between the cost of providing wide voltage tolerances in appliances as opposed to the cost of providing a narrow spread in distribution voltage.

R. A. Hentz (Philadelphia), speaking for an "even ratio" system, advocated a separate line of 208-volt motors for four-wire systems. Removal of the 5 per cent penalty in the price of two lines of motors would greatly alleviate several situations, he said. But D. K. Blake (G.E.) and C. A. Powel (Westinghouse) suggested a compromise on motors designed to operate on either voltage and thus escape the inevitable price increment for a dual line. Otherwise, said Blake, the situation might precipitate a trend toward a 125-volt lamp. R. T. Henry (Buffalo) said the differential was far more than 5 per cent when one had to buy a one-third larger 240-volt motor to get the torque of a 208-volt motor on 208 volts. C. B. McManus (Georgia Power) said many customers move from 230 to 208-volt territories and a single line would be advantageous.

Meter Standards

Of 15,000 printed and 10,000 bound, some 4,100 copies of the Meterman's Handbook have already been sold, reported A. E. Silver to the electrical equipment committee on behalf of the meters and service committee. That group is attempting to develop a universal specification for service-entrance cable so as to make one product serve for both service drop and service entrance function. It will also try to reduce the variety of sizes called for and provided. E. A. Lefever (Buffalo) is heading a committee on standardization of current transformer ratings for primary circuit metering. The original objective was a transformer capable of 200 per cent overload, but cost proved objectionable. The present interest is in a low-burden transformer solely for metering. One manufacturer has proposed that a



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It's a fallacy to think that Matthews Wire Clips are only used on guy wire to do away with the time and guy wire wasted serving above the guy clamp. For every Matthews Wire Clip sold for the purpose mentioned above 500 are sold for holding service drop wires. They save time and waste of twisting wires back on themselves. Make neater job as shown in photograph above.

The patented locking tongue shown in photograph below is inserted between the wire forming the loop and the clip is clamped tight over the insulation with pliers or wire connectors.

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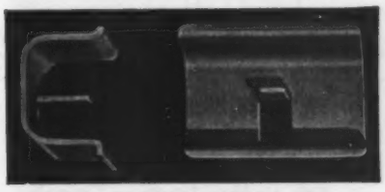

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100-amp. transformer be called a 50-amp. one to be used with a 1¼-amp. watt-hour meter so as to reconcile the feasible load-accuracy ranges of 1-125 per cent for the current transformer with the 4-400 per cent of the watt-hour meter by, in a way, multiplying one of them by four. The utilities are demurring at the added test facilities required. On the whole, low-burden design seems to offer more promise than oversizing.

Rural Meters

Apparently few, if any, of the "share cropper" meters were ordered by REA co-operatives and none manufactured, said A. E. Silver. Utilities have been surveyed to ascertain whether a reasonable number of obsolete meters (still adequate for rural loads) could be offered to manufacturers for resale. Recently REA opened bids on a "2 per cent" meter with liberal tolerances on voltage and temperature performance. The low bidder offered $6.98, with the privilege of withdrawing in 90 days if the orders didn't total $150,000 in that time, according to reports.

The meter committee, he said, was not particularly favorable toward a cyclometer register because it takes more light and longer to read, have to get close to it, visual angle is smaller than for the clock dial, maintenance cost is greater and it offers variable friction (important on light loads).

Protector Tubes

In an operating report of the transmission group of the transmission distribution committee D. M. Bunn cited experience with ten companies with some 10,000 protector groups on more than 500 miles of transmission line, reporting it as "generally successful." However, one company achieved only fair results with an experimental lot of tubes on 220 kv. due to complications involving multiple tube operation. It charged that performance was not as good for this voltage as on lower voltages.

Most of the companies are repainting or varnishing tubes that have been in service four to five years to repair the inroads of local weather conditions on exterior tube finish. One of the ten companies that has investigated weathering of tubes reported flaking of varnish finish on tube sides exposed to sun, checking on glyptal paint finish, negligible weathering of paper base Bakelite tube, but distinct checking of fibre tubes. Maintenance of paint coating on fibre tubes for preservation was indicated.

Bore enlargement data for the reporting companies was limited and erratic.

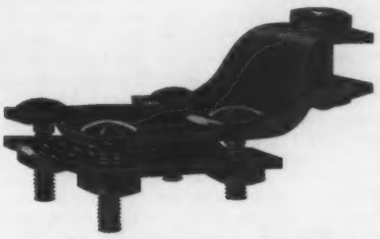
Maximum spacing of tubes on wood installations appeared to be on an economic basis, dependent on importance of the line and the degree of protection desired. Low values of ground resistance was not considered with equal importance by reporting companies. Values ranged from no fixed value to a 5-ohm maximum, with an average of 15 to 20 ohms maximum indicated. One company attempted to cut installation cost of tubes on wood poles by rearranging conductor configuration so that one conductor shielded the remaining two. Tubes were installed in this phase as dictated by ground resistance, resulting in spacing of about 300 ft. Operation of 26.4-kv. line since has been satisfactory and this year addition of 499 tubes on an additional 40½-mile line is indicated by this company.

Hydraulic Session

At the hydraulic power sessions discussion centered around design of trash racks, maintenance of turbine runners by metallizing and the repair of a large hydro-electric turbo generator shaft in place. Repair of the turbo-generator shaft as described by E. B. Strowger (Buffalo Niagara & Eastern) required the building of a special boring mill which was dropped over the turbine shaft and in which the tool revolved, thus permitting the repair to be made with the turbine in place.

C. F. Merriam (Pennsylvania Water & Power Company) recommended the revival of past studies of river flow on a secular basis to show trends which might later be correlated with trends in meteorological phenomena in a cause-effect relation. He expressly warned, however, against careless assembly and incautious interpretation of such data as prejudicial to the value of findings and continuance of such a study program.

Reporting of the discussions of the metering and services and the prime movers committees was not authorized. The transmission and distribution committee has set October 14 at Atlanta tentatively for the next meeting.



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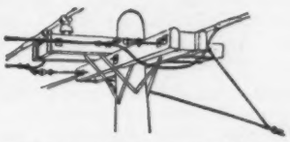

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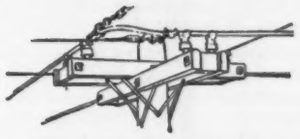
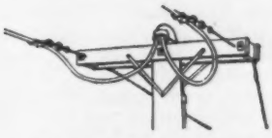


Outside Turns, Straight Guys



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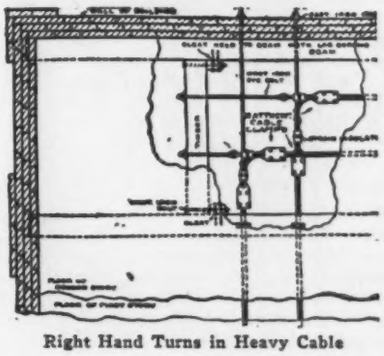

Right Hand Turns in Heavy Cable

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Sales Opportunities

OXFORD, OHIO—Cincinnati Gas & Electric Co., Cincinnati, plans new power substation on Spring Street, Oxford, where tract of about 1 acre of land has been acquired. Work will include extensions in transmission lines for connection with high-tension system. Columbia Engineering Corp., 323 Plum Street, is engineer.

VOLIN, S. D.—Interstate Power Co., Dubuque, Iowa, plans installation of distributing lines at Volin, where light and power franchise has been granted. Also will make extensions in transmission in that area. Work is scheduled to be carried out this spring.

DETROIT, MICH.—Chrysler Corp., 341 Massachusetts Avenue, Detroit, plans installation of motors and controls, duct lines, regulators, panel boards, conveyors, electric hoists and other equipment in new one-story addition, 400x1,000 feet, to automobile plant on Oakland Avenue, Highland Park district. Cost reported close to $900,000. Albert Kahn, Inc., New Center Building, is architect and engineer.

PORTLAND, ORE.—Administrator, Bonneville Project, Department of Interior, 811 N. E. Oregon Street, Portland, receives bids until May 31 for quantity of pole line and guy hardware for new Covington-Tacoma 115-kv. transmission line of Bonneville system (Circular 1017).

BROWNFIELD, TEX.—City Council plans extensions and improvements in municipal power plant, including installation of additional equipment. Cost estimated at $90,000 and bond issue in that amount has been authorized. Proposed to begin work soon.

HASTINGS, NEB.—Board of Public Works, Charles Anderson, chairman, has rejected bids recently received for turbine-generator, condenser and accessory equipment for municipal power plant, where expansion and improvements are being made. New bids are scheduled to be asked soon. Entire project will cost about $280,000. Black & Veatch, 4706 Broadway, Kansas City, Mo., are consulting engineers.

WOODSTOCK, ILL.—Water and Light Committee has been authorized by City Council to carry out modernization and improvements at municipal power plant, to include installation of transformers and accessories, new stoker, mechanical-draft fans and other equipment.

LOUISVILLE, KY.—Frankenmuth-Kentucky Brewing Co., 1445 South Fifteenth Street, Louisville, plans installation of motors and controls, conveyors, duct lines, panel boards and other equipment in new two-story and basement addition for expansion in bottling and other production divisions. It will be equipped for initial bottling capacity of 100,000 bottles daily. Cost estimated close to $250,000. Work will be placed under way at early date. Main offices of Company are at Bay City, Mich.

WASHINGTON, D. C.—General Purchasing Officer, Panama Canal, Washington, receives bids until May 28 for fractional-horsepower motors, connecting links for transmission system, knife switches, carbon brushes and other electrical equipment (Schedule 4048).

PHILADELPHIA, PA.—Bureau of Yards and Docks, Navy Department, Washington, D. C., will arrange an appropriation of about $445,000 for expansion and improvements in power plant at navy yard at Philadelphia, with installation of additional equipment for increased capacity. Project will include extensions and modernization in electrical distribution system.

BUFFALO, N. Y.—Buffalo Niagara Electric Corp. has plans maturing for extensions and improvements in electrical distribution system in different parts of city, including several new underground circuits in downtown district. Also will make extensions and betterments in street-lighting system in various sections of city, including new lighting units and other facilities. Entire project will cost about $975,000, and will form part of 1940 expansion program of company.

BROOKLYN, N. Y.—Signal Corps Procurement District, Army Base, Fifty-eighth Street and First Avenue, Brooklyn, receives bids until June 3 for 39, 390 to 70,700 lineal feet of cable; 103,020 lineal feet of cable; and 2265 to 22,650 lineal feet of cable; different types in three cases noted; and for quantity of cable reels (Circular 434); also, at same time, for 100 test sets (Circular 435).

PITTSBURGH, PA.—Duquesne Light Co. has plans under way for alterations and improvements in steam-electric generating station on Brunot Island, including interior changes and installation of equipment. Cost estimated about $110,000. Project is scheduled to be carried out this spring.

BALTIMORE, MD.—Rustless Iron & Steel Corp., 2400 East Chase Street, plans installation of motors and controls, duct lines, regulators, conveyors and other equipment in new one-story addition to mill, to be used for metal-melting division. Cost reported over $500,000. This is part of an expansion program at plant, begun a number of months ago and previously referred to in these columns.

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Chicago Power Unit Hearing Set by FPC

Hearings will be opened in Chicago June 3, the Federal Power Commission announces, at which time the commission will present results of a two-year investigation of the Chicago District Electric Generating Corporation. At the same time the Federal Power Commission states the corporation will be given the opportunity to offer evidence relevant to the inquiry.

Chicago District Electric Generating Corp. generates and sells power to Commonwealth Edison and to Northern Indiana Public Service. Common stock is reported to be owned entirely by the Edison company, which takes 80 per cent of the generating corporation's output and allocates the remainder to the Northern Indiana company.

Gross property investment reported by the generating corporation aggregates $43,056,000, according to the latest figures, while gross annual revenues for the twelve months ended June 30, 1939, amounted to $9,625,000. In advance of the hearing the Federal Power Commission announces that schedule and reports filed by the generating corporation indicate that its wholesale rates might place an undue burden upon the retail electric customers of the two purchasing utilities.

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(Continued on opposite page)